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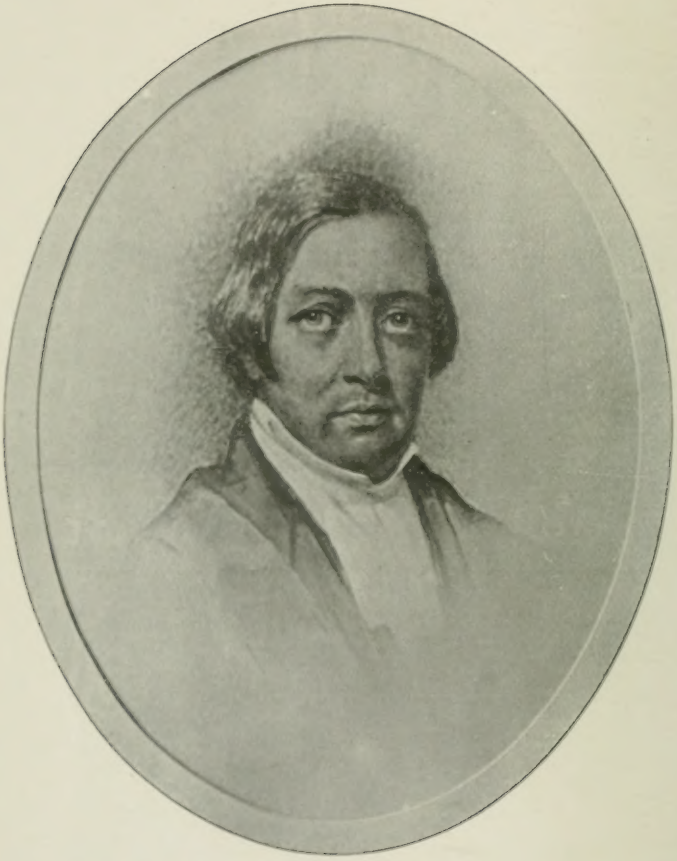

HON. ROBERT BALDWIN SULLIVAN.

SURVEYOR GENERAL, 1838-40.

No. 14.

PROCEEDINGS

OF THE

ASSOCIATION

OF

Ontario Land Surveyors

ORGANIZED 1886. INCORPORATED 1892.

AT ITS

SEVENTH ANNUAL MEETING

SINCE INCORPORATION.

HELD AT

TORONTO

28th February and 1st and 2nd March,

1899

Being the Fourteenth Annual Meeting of Land Surveyors for Ontario.

The Eighth Annual Meeting of the Incorporated Association will be held in Toronto, commencing on Tuesday, 27th February, 1900.

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PRINTED FOR THE ASSOCIATION BY
HENDERSON & CO., LOMBARD STREET,
TORONTO.

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1901

PATRONISE OUR ADVERTISERS.

NOTICES.

Members and others will be supplied with copies of the Annual Reports for 1886, 1887, 1888, 1889, 1891, 1892, 1893, 1894, 1895, 1896, 1897, or 1898 upon remitting to the Secretary fifty cents for each copy required.

In addition to exchanges from eight kindred Societies, members and associates not in arrears of dues will this year receive copies of the "Manual" issued by the Association, also the Report of the Clerk of Forestry and the Report of the Provincial Instructor in Road Making.

Each member of the Association is reminded of the fact that for the next Annual Meeting a good programme is most desirable, and to ensure its preparation it is not now too early to bear the matter in mind.

In addition to its use as a library, the Repository now serves as a drafting room for members when copying Crown Lands plans and notes.

Published annually by the Association of Ontario Land Surveyors. Edition, 1350 copies; price, 50 cents.

PATRONISE OUR ADVERTISERS.

PREFACE.

To the Members of the Association of Ontario Land Surveyors:

The Proceedings of the Association at its Seventh Annual Meeting are herewith presented.

Appended will be found the By-Laws of the Association and the papers used at the session of the Board of Examiners in February last.

Your consideration of the advertisements appearing in our columns is requested.

Respectfully submitted on behalf of the Council,

A. J. VAN NOSTRAND,

Secretary.

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ASSOCIATION OF

ONTARIO LAND SURVEYORS

(INCORPORATED 1892)

Organized 23rd February, 1886.

OFFICERS FOR 1899-1900.

PRESIDENT.

HERBERT J. BOWMAN, O.L.S., - - - - - - Berlin.

VICE-PRESIDENT.

FRED L. FOSTER, O.L.S., - - - - - - - Toronto.

CHAIRMAN OF COUNCIL.

MAJOR VILLIERS SANKEY, O.L.S., - - - - - Toronto.

SECRETARY-TREASURER.

A. J. VAN NOSTRAND, O.L.S., - - - - - - Toronto.

MEMBERS OF COUNCIL.

HON. J. M. GIBSON, Commissioner of Crown Lands, - Toronto.

GEO. B. KIRKPATRICK, Toronto.
ALEX. NIVEN, Haliburton. — For Term ending April, 1902.

J. L. MORRIS, Pembroke.
JAS. DICKSON, Fenelon Falls. — For Term ending April, 1901.

VILLIERS SANKEY, Toronto.
J. W. TYRRELL, Hamilton. — For Term ending April, 1900.

AUDITORS.

A. W. CAMPBELL, - - - - - - - - - Toronto.
H. L. ESTEN, - - - - - - - - - - Toronto.

BANKERS.

Imperial Bank of Canada (Yonge Street Branch), Toronto.

COMMITTEES, 1899-1900.

STANDING.

LAND SURVEYING.—H. H. Gibson (Chairman), E. Bazett, Wm. Galbraith, M. Gaviller, C. J. Murphy, A. Niven, T. B. Speight, J. F. Whitson.

DRAINAGE.—W. F. Van Buskirk (Chairman), A. S. Code, John Davis W. B. Ford, E. Gardiner, J. L. Morris, Jno. Roger, Geo. Ross, Geo. Smith.

ENGINEERING.—H. K. Wicksteed (Chairman), M. J. Butler, A. W. Campbell, Willis Chipman, W. M. Davis, J. D. Evans, T. Harry Jones, J. L. Morris.

ENTERTAINMENT.—A. P. Walker (Chairman), H. J. Browne, H. L. Esten, P. S. Gibson, G. B. Kirkpatrick, V. Sankey, T. B. Speight.

PUBLICATION.—K. Gamble (Chairman), H. J. Browne, F. L. Foster, G. W. McFarlen, W. A. McLean, J. F. Whitson.

TOPOGRAPHICAL SURVEY.—Otto J. Klotz (Chairman), Geo. B. Abrey, C. A. Bigger, G. L. Brown, M. J. Butler, Willis Chipman, Jno. Galbraith, J. E. Schwitzer.

SPECIAL.

REPOSITORY AND BIOGRAPHY.—Willis Chipman (Chairman), H. J. Bowman, H. L. Esten, M. C. Schofield, C. Unwin, E. T. Wilkie, H. O. Wood,

EXPLORATION.—M. Gaviller (Chairman), Lewis Bolton, W. A. Browne, T. R. Deacon, Jas. Dickson, E. Stewart, J. W. Tyrrel, C. H. Wallace.

PROGRAMME OF THE

Association of Ontario Land Surveyors

(INCORPORATED.)

AT ITS SEVENTH ANNUAL MEETING HELD IN TORONTO,
28th FEBRUARY, 1st AND 2nd MARCH 1899.

PROGRAMME.

Tuesday, 28th February—Morning at 10 o'clock.

AT THE REPOSITORY, PARLIAMENT BUILDINGS.

Meeting of Council.

Meeting of Standing and Special Committees

Afternoon at 2 o'clock.

Reading of minutes of previous meeting.

Reading of correspondence.

Report of Council of Management (including reports of Board of Examiners and Secretary-Treasurer.) Villiers Sankey, Chairman, Toronto.

President's Address.

Report of Committee on Publication. Killaly Gamble, Chairman, Toronto.

Report of Committee on Repository and Biography. H. L. Esten, Chairman, Toronto.

Report of Committee on Polar Research. J. W. Tyrrell, Chairman, Hamilton.

Paper—"Permanent Way." W. E. McMullen, St. John, N.B

Paper—"Progress of Gold Mining in the Central Belt of the Rainy River District." —H. W. Selby, Dinorwic.

Paper—"Surveying in the Mining Lands of Ontario." F. L. Foster, Mine Centre.

Paper—"Dominion Lands Surveys." C. F. Aylsworth, Jr., Madoc.

Evening at 8 o'clock.

Paper—"More Reminiscences of an Old Land Surveyor." C. Unwin, Toronto.

Report of Committee on Exploration. James Dickson, Chairman, Fenelon Falls.

Paper—"Some Incidental Benefits from the Growth of Forests." Thomas Southworth, Toronto

Paper—"Azimuths." L. B. Stewart, Toronto.

Paper—"Explorations." James Dickson, Fenelon Falls

Wednesday, 1st March—Morning at 10 o'clock.

Report of Committee on Engineering, with Question Drawer. Willis Chipman, Chairman, Toronto.

Paper—"Highway Culverts and Bridges." A. W. Campbell, Toronto

Paper—"The Calculation of Strains in Bridge Trusses." James Warren, Walkerton.

Paper—"Railway Location Work." J. D. Evans, Trenton.

Afternoon at 2 o'clock.

Report of Committee on Land Surveying, with Question Drawer. A. Niven, Chairman, Haliburton
Paper—"Our Professional Standing." B. J. Saunders, Fort William
Paper—"Survey of the Boundary Line Between Nipissing and Algoma Districts." A. Niven, Haliburton
Paper—"A Trip to the Yukon and Return." Lewis Bolton, Listowel.
Paper—"The Registry Act." P. S. Gibson, Willowdale.
Paper—"Open Questions." H. J. Bowman, Berlin.
Report of Committee on Topographical Survey." Otto J. Klotz, Chairman, Ottawa

Evening at 8 o'clock.

ANNUAL DINNER

A. P. Walker, Chairman of Committee on Entertainment.

Thursday, 2nd March—Morning at 10 o'clock.

Report of Committee on Drainage, with Question Drawer. George Ross, Chairman, Welland
Paper—"Drains of Field Tile." W. F. Van Buskirk, Stratford.
A Suggested Amendment to the Ditches and Watercourses Act. George Smith, Woodville.
Paper—"The Lake Wawanosh Drainage Scheme." John H. Jones, Sarnia
Paper—"The Payne River Drainage Scheme." T. H. Wiggins, Cornwall
Report of Committee on Entertainment. A. P. Walker, Chairman, Toronto
Report of Auditors A. W. Campbell and H. L. Easten, Toronto
Unfinished Discussions

Afternoon at 2 o'clock.

Ratification of New By-Laws
Unfinished Business
New Business
Nomination of Officers (President, Vice-President, Two Members of Council Sec'y-Treasurer, and Auditors.)
Appointment of Scrutineers
Adjournment

Minutes of the Seventh Annual Meeting

OF THE

ASSOCIATION OF

ONTARIO LAND SURVEYORS

Held at the Repository, Parliament Buildings, Toronto, on

FEBRUARY 28th, MARCH 1st and 2nd, 1899.

MORNING SESSION.

Meeting of Council.
Meeting of Standing and Special Committees.

AFTERNOON SESSION.

The seventh Annual Meeting opened at 2 o'clock p.m., the President, Mr. Peter S. Gibson, Willowdale, in the chair.

The Minutes of the previous meeting, as printed in the "Proceedings" for 1898, were taken as read, and adopted on motion of the Secretary, seconded by Mr. Sewell.

No correspondence.

Mr. Sankey, Chairman of Council of Management, presented the Report of the Secretary-Treasurer and Financial Statement, and moved that the Financial Statement be referred to the Auditors for report, seconded by Mr. H. J. Bowman, and carried.

Captain Killaly Gamble read the Report of the Committee on Publication, and moved its adoption, seconded by Mr. J. W. Tyrrell. Carried.

The President then read his address, which was received with applause.

The report of Committee on Polar Research was read by the Chairman of the Committee, Mr. J. W. Tyrrell.

On the motion of Mr. Tyrrell, seconded by Mr. Dickson, the report of the Committee was adopted.

Paper: "Progress of Gold Mining in the Central Belt of the Rainy River District," by H. W. Selby, Dinorwic, was read by Mr. H. de Q. Sewell. After discussion the paper was, on motion, received and ordered to be published.

Paper: "Surveying in the Mining Lands of Ontario," by Mr. F. L. Foster, Mine Centre, was read by the writer.

It was moved by the Secretary, seconded by Mr. J. W. Tyrrell, "That the paper be received and printed in the Proceedings of the Association." Carried.

Mr. Dickson read the report of the Committee on Exploration, and moved its adoption, seconded by Mr. J. W. Tyrrell. Carried.

At 5 o'clock p.m. an adjournment was made till 8 o'clock p.m.

Evening Session.

At 8 o'clock p.m. the meeting was called to order by the Vice-President, Mr. H. J. Bowman.

A paper on "Explorations" was read by Mr. James Dickson, and was received with applause and adopted.

Paper on "Azimuths," by Prof. L. B. Stewart, of Toronto, was read by him. He illustrated his paper by a diagram on the board. In his opening remarks he said:

"A short time ago in looking over a back number of the Proceedings of the Association, I read Capt. Deville's paper on this subject, 'The Determination of Time by Observation of Stars in the vertical of Polaris,' and I set to work to see if a method could not be derived for determining the azimuth also from the data. The formulae given by Capt. Deville in his paper, and on which the tables in the Manual of the Dominion Land Surveys are founded, give, first of all, an expression for the perpendicular let fall from the pole on the vertical circle, the transits across which are observed. And then the hour angle is given in terms of that perpendicular distance. I set out from a different point and finally worked out an expression, and on comparing it with the formulae given in Capt. Deville's paper, I found it was nearly equivalent to his two formulae. The reason of the difference is quite obvious on an examination of his formulae.

"Then I continued the investigation and found also an expression for the azimuth in terms of the same data. Thus in my wanderings through mathematical symbols I ran across several expressions that I thought possibly might be useful, hence this paper." (Reads paper).

It was moved by Capt. Gamble, seconded by Mr. Van Nostrand, "That Prof. Stewart's paper be received and printed in the Proceedings of the Association." Carried.

The Report of the Committee on Repository and Biography was read by the Chairman of the Committee, Mr. H. L. Esten, Toronto, who moved its adoption, seconded by Mr. H. de Q. Sewell.

The motion to adopt was carried.

Mr. C. Unwin's paper, entitled "More Reminiscences of an old Land Surveyor," was read by Mr. H. L. Esten, and was received with applause.

At 10 o'clock p.m. the meeting adjourned.

Morning Session.

March 1st, 1899.

At 10 o'clock a.m. the meeting was opened by the President, Mr. Peter S. Gibson, in the chair.

A paper was read on "Culverts and Bridges," by Mr. A. W. Campbell, Toronto. He prefaced his paper with the following remarks:

"I find the question of the material which should be used in the construction of Culverts and Bridges is a matter which is giving Municipal Councils and Engineers considerable worry and trouble at the present time, and for that reason I thought I would take up this subject for discussion this morning.

"When timber was plentiful in the country of course it was the most economical material for use in these structures, but at the present time that material has been pretty well stripped from the face of the older townships, and we must look for some other material, something of a more durable character. For that reason I strongly recommend the use of iron and steel for superstructures and concrete and stone for foundations.

"Also in large culverts with a span of from five feet up to twelve or fifteen feet, I would recommend, where possible, concrete arches, and, in the smaller sluices, concrete pipes."

Mr. Campbell then read his paper, which was received with applause.

Mr. Tyrrell moved that the paper be received and adopted. He also said: "I consider this paper one of the most valuable we could have. We certainly, as engineers as well as surveyors, require education in this line and there is a vast amount of up-to-date information contained in this paper, which will be much appreciated in our Report."

Mr. Kirkpatrick, in seconding the motion said: "I think Mr. Campbell is deserving of the thanks of the Association, even if it is not the usual custom. If I were a working engineer I would hold up both hands for a vote of thanks to him."

A paper on "Railway Location Work," written by Mr. J. D. Evans, of Trenton, was presented by him to the meeting, and Mr Kirkpatrick moved the paper be received and adopted, seconded by Mr. Lewis Bolton, and carried.

Afternoon Session.

At 2 o'clock p.m. the meeting resumed, the President in the chair.

A paper on "The Calculation of the Strains in Bridge Trusses," by James Warren, of Walkerton, was read by Mr. J. L. Morris.

It was moved by Mr. James Dickson, seconded by Mr. Lewis Bolton, that the paper be received.

A paper, entitled "Some Incidental Benefits from the Growth of Forests," written by Mr. Thomas Southworth, of Toronto, was read by Mr. Whitson.

It was moved by Mr. James Dickson, seconded by Mr. John Davis, that the paper be received.

Mr. Lewis Bolton, of Listowel, read a paper on "A Trip to the Yukon and Return," which was received with applause.

A paper on the "Survey of the Boundary Line Between Nipissing and Algoma Districts," by A. Niven, Haliburton, was read by him, and, on motion, adopted.

Mr. Sankey then presented the report of the Committee on the Ontario Bill of the Canadian Society of Civil Engineers.

In presenting the report Mr. Sankey said:

"You may remember that at the last meeting a Special Com-

mittee was appointed to meet a Special Committee of the Engineers' Association in view of their proposed legislation for incorporation in the Province of Ontario. I would be very glad if every member present would state his own personal conviction in the matter, so that the Committee and the Council may see what the real feeling of our Association is with regard to this matter.

"Prior to the meeting of last year a deputation from the Canadian Society of Civil Engineers waited on our Council and asked if we would be prepared to appoint a Committee to meet them and discuss the matter of incorporation with them. The Council were of opinion that the matter was of such importance that they did not feel it would be just for them to deal with it. But they assured the engineers that a Committee would be appointed when the Association met. On the meeting of the Association a Committee was appointed, of which I was the chairman, and this is the report we brought in last year. (Reads report of last year, printed in the Proceedings of 1898.)

"No special negotiations between the two Associations have taken place since. A bill has been introduced into the House this year. It was presented by Mr. Russell and got its first reading on the 22nd February, 1899.

"After the report of our Special Committee was presented last year, it was moved that Messrs. Kirkpatrick, Niven, and Sankey be appointed a committee to look after the interests of our Association in any legislation that may be proposed by the Canadian Society of Civil Engineers, and I now beg to present the report of that Special Committee."

Mr. Sankey then explained the provisions of the Engineers' Bill.

"In presenting this report I may add that it would appear to me advisable to take action as suggested by the Committee for this reason: they came to us last year and we neither broke off negotiations nor did we part with anything but good feeling. Our negotiations were carried on in a thoroughly businesslike and amicable manner, and I would be sorry if the Ontario Land Surveyors should in any way set up a barrier against the engineers.

In concluding his remarks, Mr. Sankey moved the adoption of the report of the Committee, seconded by Mr. Niven, and carried.

At 6.20 o'clock p.m. the meeting adjourned until the following morning, as the annual dinner took the place of an evening session.

Morning Session.

March 2nd, 1899.

At 10 o'clock a.m. the meeting was called to order by the President, Mr. Gibson in the chair.

The report of the Committee on Topographical Survey, Otto J. Klotz, Chairman, Ottawa, was read by Mr. John Roger, who moved that the report be adopted, seconded by Mr. Wicksteed, and carried.

The report of the Council of Management was read by Mr. Villiers Sankey. With the report he also presented the report of the Board of Examiners and that of the Secretary-Treasurer.

On motion of Mr. Sankey, seconded by Mr. John Davis, the report was adopted by the meeting.

Mr. Foster read a circular presented by the Canadian Historical Association requesting all who could to furnish that Association with specimens of old surveys, exhibits to show the laying out of the various parts of the Province for settlement, and instruments used, maps, charts, plans, field notes, models of early mechanical and domestic machinery. Miss FitzGibbon, Secretary of Association.

Report of Committee on Drainage, with Question Drawer, George Ross, Chairman, Welland, was read by the Chairman of the Committee, who moved its adoption, seconded by Mr. Bowman. Carried.

Report of Committee on Land Surveying, with Question Drawer. A. Niven, Chairman, Haliburton. Mr. Niven read the report and moved its adoption.

Mr. Niven then read last question in Question Drawer and moved the adoption of the report. Seconded by Mr. Lewis Bolton and carried.

It was moved by Mr. Bowman, "That the Council be instructed to take such action as may appear to them best to uphold the standing of our Association in matters connected with planting of monuments, and having particular reference to the case in Hamilton."

Before this motion was put, it was decided to leave the matter open until Mr. Sankey came and that the matter be referred to him, he being in close touch with the solicitor.

At 1 o'clock p.m. the meeting adjourned to 2 p.m.

Afternoon Session.

At 2 o'clock p.m. the meeting resumed, the President, Mr. Gibson, in the chair.

A paper on "The Payne River Drainage Scheme," by T. H. Wiggins, was read by him.

It was moved by Mr. Foster, seconded by Prof. Stewart, that it be received and adopted. Carried.

Paper, "Drains of Field Tile," by W. F. Van Buskirk, of Stratford, was then read by the writer, and received with applause.

The report of the auditors was presented by Mr. W. A. McLean, acting for Mr. Campbell.

It was moved by Mr. T. H. Jones, seconded by Mr. Foster, and carried, "That the report of the Auditors be received and adopted."

Paper, "Open Questions," by Mr. H. J. Bowman, of Berlin, was presented by him.

It was moved by Mr. Jones, seconded by Mr. Foster, and carried, "That it be received and adopted."

Discussion on the Bill to incorporate the Canadian Society of Civil Engineers in Ontario followed, and it was resolved that To the Committee for the consideration of the Canadian Society of Civil Engineers' Bill, composed of Messrs. Sankey, Kirkpatrick, and Niven, be added the names of Messrs. Wicksteed and J. S. Morris, and that the said Committee be continued in their duties.*

It was moved by Mr. G. B. Kirkpatrick, seconded by Mr. James Dickson, and resolved, "That the Secretary be instructed to address Joseph Kirk, C. Unwin, F. H. Lynch-Staunton, and M. C. Schofield, expressing regrets that they have been unable to be present at this meeting and conveying the good wishes of the members in attendance." Carried.

It was moved by Mr. W. F. Van Buskirk, seconded by Mr. James Dickson, and resolved, "That owing to the lateness of the hour, the paper by Mr. John H. Jones, entitled, "Perche Drain Dredging Work," be taken as read and printed in the Proceedings.

Photographs of machinery used in this work were presented for inspection.

A paper on "Our Professional Standing," by Mr. B. J. Saun-

*The above Committee met the Legislation Committee of the Can. Soc. of C. E. and the changes indicated in the previous discussion of the bill were conceded by the latter andop position of our Association was withdrawn. Owing to other causes the bill when discussed before a committee of the Legislature was held over for a future occasion. *Secretary*.

ders, Port William, was taken as read, on motion of Mr. F. L. Foster, seconded by Capt. Killaly Gamble.

A paper by Mr. W. E. McMullen, on "Permanent Way," was taken as read on motion of Mr. V. Sankey, seconded by Capt. K. Gamble.

On motion of Mr. Sankey, seconded by Captain Gamble, it was resolved, "That the paper by Mr. George Smith, entitled, "A Suggested Amendment to the Ditches and Watercourses Act," be taken as read and printed in the Proceedings.

The report of the Committee on Entertainment was, on motion of Mr. A. P. Walker, seconded by Mr. F. L. Foster, taken as read, and ordered to be printed in the Proceedings.

Mr. Sankey—In the presenting of the report of the Council this morning and the amended By-laws I presume they are carried as amended and will be printed. Carried.

Moved by Mr. Kirkpatrick, seconded by Mr. Niven, and resolved, "That we have learned with regret of the removal by death since our last meeting of Messrs. Joseph DeGurse, Albert Fowlie, Thomas B. Gilliland, Thomas R. Hewson, Sherman M. Malcolm, John H. Ogilvie, and James A. McMillan, and that the Secretary be requested to convey to the relatives of the above this expression of sympathy for them in their bereavement and to insert in the forthcoming annual report an obituary notice of each." Carried.

Moved by Mr. Whitson, seconded by Mr. Jones, "That any omissions or clerical errors in the records of this meeting now in the hands of the Secretary and the stenographer, be corrected by the Committee on Publication before publishing the same." Carried.

NOMINATION OF OFFICERS:

PRESIDENT.

Mr. Dickson moved that the Vice-President, Mr. H. J. Bowman, be elected President for the ensuing year. Seconded by Mr. A. P. Walker. Carried unanimously.

VICE-PRESIDENT.

Mr. Morris moved Mr. F. L. Foster's nomination for Vice-President. Seconded by Mr. T. H. Wiggins, and carried unanimously.

SECRETARY-TREASURER.

Mr. T. H. Jones nominated Mr. A. J. Van Nostrand. Seconded by Mr. A. Niven, and carried unanimously.

MEMBERS OF COUNCIL.

Mr. Sankey nominated Mr. James Dickson.
Mr. T. H. Jones nominated Mr. H. K. Wicksteed.
Mr. J. L. Morris nominated Mr. W. F. Van Buskirk.
Mr. A. P. Walker nominated Mr. A Niven.
Mr. Wiggins nominated Mr. G. B. Kirkpatrick.
Mr. Walker nominated Mr. Hutcheon.
Mr. A. J. Van Nostrand nominated Mr. John Davis, Alton.
Mr. Foster nominated Mr. A. P. Walker.
Capt. K. Gamble nominated Mr. George Ross, of Welland.

AUDITORS.

Mr. Kirkpatrick moved, seconded by Mr. A. Niven, "That the present Auditors, Messrs. Campbell and H. L. Esten, be re-elected.

SCRUTINEERS.

The President appointed Messrs. Whitson and Gamble.

The President declared the persons nominated for the offices of President, Vice-President, Secretary-Treasurer and Auditors, as above, to be elected by acclamation.

It was moved by Mr. A. Niven, seconded by Mr. G. B. Kirkpatrick, and resolved, "That the sum of $200 be granted to the Secretary-Treasurer as a slight remuneration for his services during the year.

It was moved by Mr. Van Buskirk, seconded by Mr. A. Niven, "That the Auditors auditing the accounts for 1898 receive the sum of $5 each for their services." Carried.

Mr. T. Harry Jones moved "That the President leave the chair, and that the chair be taken by Capt. Van Buskirk, and that the thanks of the Association be tendered to our retiring President for the very able manner in which he has discharged the arduous duties of his office during the past year. No words will express our appreciation of his services. He is one of the oldest members of this Association, and one of the oldest practising surveyors in the Province, and he has at all times rendered us able aid. One good thing has taken place on our electing him to that position, and that is, we have him presiding at our annual dinner. Seconded by Mr. Niven and carried unanimously.

Mr. Gibson expressed his pleasure at receiving this vote of thanks and his desire to serve the Association in every way in his power.

Mr. A. J. Van Nostrand, in moving that a vote of thanks be tendered to Major Sankey, the Chairman of the Council, for the able and efficient manner in which he had performed his duties, said: "I can speak personally in this matter as no one else can, because he and I alone know how often the Secretary goes down to the City Hall to bother him when he is in the midst of some Esplanade agreement or other important duties, and all the work he does, the details of which it would take some time to enumerate, he does for love of the Association and the good of the profession at large. I think we are all indebted to him for more than the majority of us know.

Mr. Niven seconded this motion, stating that he knew Mr. Sankey had rendered great assistance to the Association at all times. Carried unanimously.

Mr. Sankey replied to the motion, stating that the performing of his duty to the Association gave him the greatest pleasure, and he desired to do his utmost to further the interests of the profession.

At 5.40 o'clock p.m. the meeting concluded by singing the National Anthem.

MEMBERS IN ATTENDANCE AT THE SEVENTH ANNUAL MEETING.

28TH FEBRUARY AND 1ST AND 2ND MARCH, 1899.

W. Beatty.
L. Bolton.
H. J. Bowman.
A. W. Campbell.
J. Davis.
J. Dickson.
H. L. Esten.
J. D. Evans.
R. P. Fairbairn.
W. B. Ford.
F. L. Foster.
J. Galbraith.
K. Gamble.
H. H. Gibson.
P. S. Gibson.
W. S. Gibson.
J. Hutcheon.
T. H. Jones.
G. B. Kirkpatrick.
H. McGrandle.
W. A. McLean.
A. J. McPherson.
J. L. Morris.
C. J. Murphy.
A. Niven.
J. A. Paterson.
J. Roger.
G. Ross.
V. Sankey.
H. DeQ. Sewell.
A. Smith.
H. Smith.
L. B. Stewart.
J. W. Tyrrell.
W.F. Van Buskirk.
A.J. Van Nostrand.
A. P. Walker.
A. T. Ward.
J. F. Whitson.
H. K. Wicksteed.
T. H. Wiggins.

RESULT OF ELECTIONS FOR 1899-1900.

President.....Herbert J. Bowman.....(by acclamation).
Vice-President.....Fred. L. Foster.....(by acclamation).
Secretary-Treasurer.....A. J. Van Nostrand.....(by acclamation).

Members of the Council of Management elected for the ensuing three years:

Geo. B. Kirkpatrick. Alex. Niven.

Auditors for the ensuing year: (by acclamation).

A. W. Campbell. H. L. Esten.

I hereby declare the above named officers elected.

A. J. VAN NOSTRAND,
Secretary-Treasurer.

Certified correct.

KILLALY GAMBLE, }
J. F. WHITSON, } *Scrutineers of Ballots.*

Under Sec. 16. Chap. 180, R.S.O., 1897 the Council appointed Mr. James Dickson to fill the vacancy caused by the resignation of Mr. F. L. Foster as member of the Council, Mr. Dickson being next to the members elected as above in the number of votes received.—*Secretary.*

PRESIDENT'S ADDRESS.

GENTLEMEN OF THE ASSOCIATION OF ONTARIO LAND SURVEYORS:

I need hardly tell you that it gives me much pleasure to address you as President. It is now about 42 years since I passed my final examination. The members of the Board of Examiners at that time were Russell, Assistant Commissioner of Crown Lands; Devine, Hawkins, Fleming, Roach, and D. Gibson. To meet the demands of the public the subjects for final examination have been so increased that at present an Ontario Land Surveyor must also be a Civil Engineer and Municipal Lawyer; he must have a theoretical and practical knowledge of Astronomy, Geology, Mineralogy, Botany, Laws relating to Mining, Registration, Drainage, Ditches and Watercourses, Municipal Law, and all Acts relating to Survey of Lands in Ontario, Levelling, Laying out Railways, and in Mathematics, Euclid, Algebra, Plane and Spherical Trigonometry, Mensuration, Laying Out and Dividing Land, etc., etc., must also be an Artistic Draughtsman, and versed in the principles of evidence, and capable of deciding at a glance the meaning of wills and other legal documents relating to the division of land. In addition to the above he must be proficient in a variety of other subjects too numerous to mention, but which will readily occur to you all, so we may say that his knowledge must extend over the surface of the earth about him, the heavens above him, and the earth beneath him, and from the certificates required of him before entering on his final examination he must be not only a scholar, but a cultured and refined gentleman.

When referring to a knowledge of statutory law, I do not mean that the surveyor has only to make himself familiar with the letter of the law, but he must also be up in the cases giving the decisions of the High Courts not only as to the meaning of statutes, but in cases where there is no statutory rule. In this way only can a surveyor be an expert in law cases, and by his reports actually block out the brief of the counsel. He must not only be well posted in his case, but be able to tell what he knows so as to command the confidence and convince the Court. To meet such circumstances and others which will readily occur to you, every O. L. S. should be a public speaker, an accomplishment which is easily acquired by our members in the regular course of their practice, if not during their course of study. I would like to impress upon the members of our Association the importance of becoming permanently established in localities where they may commence practice, since to be successful you must make yourself fully acquainted with the early, or, we may say, the original history of the locality, as to plans, field notes, instructions and reports of surveys of the townships, towns and villages and as to the original stakes and limits then

established, and whether the original surveys were single front, double fronts, or sectional surveys, and he must have full knowledge as to all special Acts as well as a critical knowledge of the Survey Act. He must be posted as to litigation of boundaries in the locality and law reports as to the same, and secure, if possible, all old field notes, plans, etc., etc., of other surveyors who may have practised in the locality. In order to be of use, such information, as well as your own notes, plans, etc., must be carefully indexed so that they may be referred to at short notice and be of use to your boys afterwards. While I do not wish to indulge in flattery, we know it is a common ambition of all good and great men to wish to be remembered by future generations. I claim that no profession presents so fair a field as ours in that respect. Only a few of our professional men and statesmen are remembered in after years, and often then only by reading some voluminous history, while the Ontario Land Surveyor in general practice has his name entered on plans, documents, etc., etc., as a guarantee of their value and correctness, which will be referred to daily during centuries to come.

I have sometimes wondered as to what becomes of so many Ontario Land Surveyors passed by the Board of Examiners, and I find on investigation that after years of experience there is a demand for them for important positions.

I might refer to the bill for incorporating the Canadian Society of Civil Engineers in Ontario. Of course an amalgamation with our Society would not do, as, while an Ontario Land Surveyor may readily prepare himself for a Civil Engineer, it would not be claimed that all members of the Canadian Society of Civil Engineers, made up, as it is, of such various classes, could qualify themselves for Ontario Land Surveyors. While I, personally, would benefit by the passage of the proposed bill and would be pleased to see it passed as a personal benefit, being myself a member of the Canadian Society of Civil Engineers, yet I am satisfied it would not be of advantage to a large number of the members of our Association, and I am of the opinion that the officials of the Association are responsible to such members in case of such legislation.

We have important legislation on hand as to the registration of plans, which we hope to see passed in order that the compiled plans so often spoken of in the Association may have a better standing, and at the same time put the paper titles of lands in such localities on a better footing. The matter will probably be discussed by the Association at this meeting.

I cannot but give expression to the pleasure to myself, as well as, I am sure, to other members of the Association, as to the harmony and pleasant intercourse that exists among the members of the Association, and we have every hope it may continue.

I am sure we are all pleased to look forward to the prospect of good times now looming up before us, and it is very gratifying to us to know that under such circumstances it is to Ontario Land Surveyors the country looks for assistance in opening up and developing the great interests of the country.

PETER S. GIBSON,
President.

REPORT OF THE COUNCIL OF MANAGEMENT.

The Council held two meetings, one on 19th April, 1898, and one on 29th December, 1898.

A number of non-residents on the list of practitioners were permitted to withdraw without payment of full arrears, each case being treated on its merits, and as was deemed in the best interests of the Association.

P. S. Gibson and A. Niven were re-appointed as members of the Board of Examiners for three-year term.

A copy of the Order in Council was received, notifying us that the Lieut.-Governor had re-appointed G. B. Kirkpatrick as member of the Board of Examiners for three years. The Standing and Special Committees, as appearing on page 6 of the printed Report of the Association for 1898, were struck by the Council.

The complaint of J. W. Tyrrell, re the removal of stone monuments planted by him, was considered. The particulars will come before the Association in "Question Drawer" of Land Surveying Committee.

The action of Foster v. Hall, re unlicensed practice in Rainy River District, was endorsed by the Council, and the cost of prosecution paid from Association funds. A conviction was secured and the practice of the defendent put a stop to.

The complaint of W. D. Heron against C. Potvin, in the County of Russell, for unlicensed practice, came before the Council, and a letter of warning was sent to Potvin. No repetition of the offence has since been reported.

The complaint of H. McGrandle, as to the running of timber berth lines by W. T. Jones, an employee of a lumber company, but not an authorized land surveyor, was investigated, but the facts disclosed did not warrant the Council in entering an action in this case. A letter of warning was sent to the parties complained against.

While the Council appreciate the delicate position in which a surveyor stands with regard to a prosecution within his own territory, we could point out the great difficulty the Council experience in securing sufficient evidence to establish a case without the open aid of some resident of the locality.

The compilation of Acts relating to land surveyors' practice in Ontario was printed, but, owing to the fact that important changes in Registry Act are expected to be made at the 1899 Session of the Legislature, it was thought wiser to issue last year only chapters 180 and 181 of R.S.O., 1897, and to delay the issue of the compilation until the result of the legislation of the present session of the Legislature is known.

A re-cast of the By-laws to suit the recent changes in the Statutes is presented herewith.

Respectfully submitted,

VILLIERS SANKEY,

Chairman of Council.

DISCUSSION.

Mr. Sankey—There is one item that we did not put into the report. During the last year I think the Association is to be congratulated on the very satisfactory settlements that we have reached with members of the Association who had got into what I may call serious arrears of dues. There were some that had allowed three or four years to climb up on them, and of course you all know it is often a very difficult thing to settle with such a man, especially if his practice has not been quite as flourishing as he would like, and others forget and do not pay their fees, but during the past year we took the list up, and except one or two instances which the Council think are really cases of hardship, we have settled almost all. I do not suppose there are more than two or three now that are over two or three years in arrears. It is about the only unpleasant work we have to do to make settlements and to try and do what we believe to be right and in the interests of the Association, without causing hardship for some of our members.

I have got here a "proof" of some of the proposed compilations of the Acts we propose to have printed and bound with the Acts that have already been issued. It will be a great benefit to Surveyors to have such a manual. We do not propose to include in this manual the Ditches and Watercourses Act; it would make the book too bulky. We are putting in references to the Fire Act, and the Line Fences Act, and a few extracts from the Railway Act

of Ontario, and it might be well to put in a few extracts from the Dominion Railway Act. I think also a specimen form of the certificate a surveyor is expected to sign on a notice of Arbitration would be useful.

REPORT OF BOARD OF EXAMINERS.

The annual examinations were held during the earlier part of February.

At this examination the marks, as fixed by the original By-laws, were adhered to on account of the short notice which would otherwise have been given to the candidates.

Copies of the papers used have been ordered to be published in the forthcoming Annual Report of the Association.

The following passed preliminary examination :

Edgar Augustus James, Thornhill.
William Alexander Beaton, London.
Stanley Herbert Fillmore, Fingal.
Frederick Conningham Denison, Toronto.

The following passed the final examination :

Charles Wilfrid McPherson, Toronto.
Carl Reinhardt, Montreal.
Finlay Donald McNaughton, Cornwall.
James John MacKay, Woodstock.
Henry Stanley Carpenter, Collingwood.

The following bonds were approved and filed :

Wilbert Silas Gibson.
John James Newman.
William Butterton Lord.
James Nevin Wallace.
James Samuel Dobie.
William Arthur McLean.
William Walter Meadows.
Franklin Joseph Robinson and
George Laing Brown.

Articles were filed by apprentices as follows:—

ARTICLES FILED.

Name of Pupil.	Name of Surveyor.	Residence.	Date of Articles.	Term.
Jackson, John Herbert	Newman, William	Windsor	Feb. 18, 1898	3 years.
Weeks, Melville Bell	Jones, T. Harry	Brantford	June 15, 1898	1 year
Shaw, John Henry	Morris, J. L.	Pembroke	June 8, 1898	1 year

REPORT OF THE SECRETARY-TREASURER.

MR. CHAIRMAN.—I beg leave to submit the following report of the official business of the Association transacted in my department between 8th March, 1898, and 28th February, 1899.

The following circulars were issued:

No. 44	Ballot for 1898-99	225
" 45	Explanation of ballot with names of candidates	225
" 46	Announcement of annual meeting, 1899	300
" 47	Programme for annual meeting	400
Letters and accounts sent from Secretary's Office		1014
Post Cards		10
Letters and Post Cards received		442
Copies of 1898 Proceedings sent to Exchanges		815
Copies of 1898 Proceedings sent to members		220
Exchanges sent to members		1300

Our exchange list has been increased until we now include the following: Engineering Society of the Ontario School of Practical Science, Iowa Engineering Society, Illinois Society of Engineers and Surveyors, Michigan Engineering Society, Ohio Society of Surveyors and Civil Engineers, Indiana Engineering Society, Wisconsin Engineering Society, Purdue Society of Civil Engineers. In the cases of some of the above we have been unable to obtain a sufficient number of copies to afford one for each of our paid up members, but we hope to be in a better position in the future.

The report of the Ohio Society for 1898 has not yet been received, and that for the Wisconsin Society will be issued as part of a double number next year.

The Council is to be congratulated upon having at last come to satisfactory adjustments with the few members who were allowing annual dues to accumulate without their making any effort or expression therefor. It has been found that in nearly every case the delinquent member had not taken the trouble to inform himself on Association matters, and satisfactory arrangements have been made since these points were explained.

The list of practitioners has been slightly diminished during the past year by the withdrawal of a number of our members who are non-residents, and our membership has suffered more at the hands of the Grim Reaper since our last Association meeting than during any similar previous period. Particulars as to our loss in this direction will be found elsewhere.

Your Secretary Treasurer takes this opportunity to remind members that all remittances to him are, or should be, acknowledged with a fair amount of promptness upon the authorized forms of the Association. Should any remitter fail to receive, within a reasonable time, an acknowledgment of the receipt of his enclosure, he would confer a favor by sending a post-card of inquiry, as,

amongst such a large number of small transactions, it is found that an average of at least one annually is lost, overlooked, or otherwise unaccounted for.

All of which is respectfully submitted.

A. J. VAN NOSTRAND,
Secretary-Treasurer.

STATEMENT OF BALANCES, RECEIPTS AND EXPENDITURES BETWEEN 8TH MARCH, 1898, AND 28TH FEBRUARY, 1899.

DR.

To balance on hand, 8th March, 1898		$1,712 19
" Amount collected from advertisements in 1897 Report	$ 3 50	
" " " " " 1898 "	51 00	
" " from Proceedings sold	4 50	
		59 00
" " Registration Fees 5 at $1.00 each	5 00	
" " Annual Dues for 1895-6, 5 at $4.00 each	20 00	
" " " " " 1896-7, 8¾ " 4.00 "	35 00	
" " " " " 1897-8, 29¾ " 4.00 "	119 00	
" " " " " 1898-9, 144 " 4.00 "	576 00	
" " " " " 1899-0, 5¼ " 4.00 "	21 00	
" " Associate Fees " 1898-9, 2 " 2.00 "	4 00	
" " " " " 1899-0, 1 " 2.00 "	2 00	
		782 00
" Accrued Interest on deposit in Savings Bank		33 97
" Receipts in Board of Examiners account (including Government grant of $200.)		470 00
		3,057 16

CR.

By amount for publishing Proceedings of 1898 meeting	$378 10	
" Amount granted to Secretary-Treasurer for 1897-8	200 00	
" " Paid for postage	80 90	
" " " Printing and Stationery (including Manual proof)	74 95	
" " " Solicitor's fees and other Law expenses	59 89	
" " " Extra copies '98 exchange reports	39 10	
" " " Expenses of members of Council	38 25	
" " " Stenographer's fees, reporting annual meeting, 1898	35 00	
" " " Office sundries, repairs, etc.	11 70	
" " " Freight and Express charges	8 76	
" " " Customs, brokerage and entries	6 12	
" " " Caretaker for Repository	5 00	
" " " Additions to Library	3 00	
" " " Cartage	2 45	
" " " Bank collections	1 75	
" " " Binding and mounting	1 25	
		$946 22
" " " Disbursements in Board of Examiners account		446 49
" Balance on hand in Savings Bank, 28th February, 1899	$1,361 94	
" " " Current account, 28th February, 1899	302 51	
		1,664 45
		$3 057 16

A. J. VAN NOSTRAND,
Secretary-Treasurer.

We hereby certify that we have examined the accounts of the Secretary-Treasurer and vouchers therefor, also Financial Statement, and have found them correct.

Respectfully submitted,

A. W. CAMPBELL.
H. L. ESTEN,
Auditors.

REPORT OF PUBLICATION COMMITTEE.

MR. PRESIDENT.—The committee feel happy in again having issued a Report of our Proceedings containing much that is of value to our profession as well as matters of public interest; and we trust that the Report has met with general approval.

We desire anew earnestly to request members sending in "Papers" to be more careful as to the accuracy, size, and elegance of the accompanying diagrams.

The Association desires to return thanks to Sir George Kirkpatrick for his kindness in furnishing a portrait of the late Mr. John Macaulay, formerly acting Surveyor-General, a biographical sketch of whom we expect to insert in our next Report.

The printing of our Report was carefully executed by Messrs. Henderson & Co. One thousand three hundred and fifty copies were printed, at a cost of $378.

The members of the Association should consider the interests of those advertising with us.

We have exchanged Reports with the following Societies:

EXCHANGES SENT TO

School of Practical Science Engineering Society	200
Michigan Engineering Society	130
Ohio Society of Surveyors and Civil Engineers	100
Illinois Society of Engineers and Surveyors	130
Indiana Engineering Society	75
Iowa Civil Engineers and Surveyors' Society	70
Wisconsin Engineering Society	20
Purdue Society of Civil Engineers	90
	815

Respectfully submitted

KELLALY GAMBLE,
Chairman.

REPORT OF COMMITTEE ON POLAR RESEARCH.

MR. PRESIDENT AND GENTLEMEN,—Your Committee on Polar Research are very sorry to have to report both poles of our globe still undiscovered; but you will be pleased to know that arrangements are now being made for the "final location" of our end of the axis during the present year, by a Canadian. Some of you are already familiar with the name of Captain J. E. Bernier of Quebec—to whose proposed Polar Expedition I refer.

I had hoped to receive a paper from Captain Bernier regarding his plans, or better still, to have had him here to address us in person, but having been unsuccessful in both these attempts, I have here a letter from Mr. Charles Baillairge, F.R.S.C., of Quebec, giving some of the details of the project, and I cannot do better than read what he says, for he seems to know whereof he writes.

The following is his letter in reply to my request for information:

QUEBEC, February 23, 1899.

MY DEAR MR. TYRRELL:

I don't know that I can enlighten you as to Bernier's proposed trip to the North Pole more than you have already been by the newspapers. In the Montreal La Presse of December, 31, 1898, issued a colored sheet containing Bernier's lecture on the subject at Montreal and a letter of mine read at the Conference, and reproduced with it.

I consider the time has arrived when it behoves us to reach the pole, and that now that so many other nations have tried their best at it and failed, it is for Canada to solve the problem. Former trips, though unsuccessful, have been very instructive as to wind and currents and drift of ice. De Long's voyage especially, and then Nansen's, have supplied the necessary data to make a final attempt a triumph. As Bernier says, all former explorers have worked against nature or natural forces, and he intends to avail himself of such aids.

He will, I believe, go by Behring's Straits as De Long did, leaving, say, in June. Getting by September to opposite the mouth of the Lena, a river from Siberian Russia, emptying into the Polar basin, he will then with his party take to the ice and foot it to the pole, the drift ice helping him on to some extent. After leaving the pole, he will walk and steer for Spitzbergen, getting there the following spring and there re-embarking with his party for Norway on his way back; or, if he only gets there in the fall of 1900, wait there till the following spring for the tourists' vessel from Norway to return him.

He will have say 100 Eskimo dogs and 100 deer, with moss for the latter, then as the loaded traineaus and kayaks at the start lighten, and as one dog after another gets fagged out, kill it to feed the others, and as the deer become less required, also due to consumption of provisions, kill one and then another, feeding on the best of their flesh and giving the remainder to the dogs, securing, of course, the pelt or furs for his return journey. He will have among other paraphernalia a boat in two sections, hinged together, so that the one half folding over the other will form a camp for the men at night or during rough weather; will use oil for light and fuel and replenish his supplies on his return from what he can get of the walrus and other blubber-bearing amphibian mammalia, a bear occasionally revivifying the larder.

If Bernier gets the money he will reach the pole, but the work has to be done on foot and not rely on a vessel taking him there. There are no storms worth mentioning in those regions, no cold severer than that of the Klondyke, and with pluck and courage they are bound to get there at last. In fact I feel just like going there myself. If Bernier cannot raise the money in Canada, he will get it in the States and plant the Stars and Stripes there instead of the flag of England, and then we will say with a voice, "What fools we were not to have made the final attempt for science and glory.

Bernier thinks it may cost him less to buy a second-hand vessel to get to the Lena and there abandon it than to pay $10,000 for a new vessel to take him there.

Very truly yours,

CHAS. BAILLAIRGE.
F. R. S. C., etc., etc.

Captain Bernier is at the present time in St. John's, Newfoundland, endeavoring to secure a suitable vessel for his voyage, and he is evidently very much in earnest.

Your Committee ventures the opinion that Bernier's plans appear to be well laid, and that his project is not unlikely to be crowned with success.

Let us hope that sufficient partiotic Canadian capital may not be lacking to enable him to plant the Canadian flag at the pole. The only serious defect we observe in the Bernier expedition is that there is not to be a land surveyor in the party.

J. W. TYRRELL.
Chairman Committee Polar Research.

DISCUSSION.

Mr. Tyrrell—I had considerable correspondence with Capt. Bernier, and had hoped to have had him present with us, but he was compelled to return immediately to St. John's, Newfoundland, on pressing business.

Most of the expeditions to the north have gone in direct opposition to what Nansen has proved to be the drift of the polar ice, and therefore have made little progress, having often found themselves further back at the end of a hard day's labor than the day before. It seems to me we might do something towards assisting the expedition now proposed.

Mr. Gibson—What do you think we might do in the way of bonusing an expedition of this kind ?

Mr. Bowman—I think the proper course would be to send an Ontario Land Surveyor along with it to ensure the success of the expedition. I do not know any Ontario Land Surveyor who would do better than our friend Mr. J. W. Tyrrell. I would vote for a grant towards it if Mr. Tyrrell would go with it. It would be an honor to have a representative with that expedition, if it is to be a Canadian expedition.

Mr. Tyrrell—It is receiving some assistance from the Dominion Government. I was not able to obtain such information regarding the expedition as I had hoped. Most of the information I got was from the Secretary of the Royal Society.

The President requested the Vice-President, Mr. Bowman, to take the chair.

Mr. Dickson—It is said it would be an honor to the profession to have one of the Ontario Land Surveyors there, but I think the honor would be to the expedition. I do not think this Association should be called upon to furnish any of the funds; we could furnish a man equal to any they could get in the Dominion. Mr. Tyrrell has had more experience in this line than any other Ontario Land Surveyor to-day, and I would be very much pleased to see him engaged by the Dominion Government to go with the expedition.

Mr. Niven—I would be very much pleased if a member of the Association of Ontario Land Surveyors would join that expedition, and I do not know of anyone more efficient than Mr. Tyrrell.

REPORT OF COMMITTEE ON EXPLORATION, 1899.

MR. PRESIDENT AND GENTLEMEN,—Your Committee on Explorations have not succeeded in securing anything new which would would be of interest to the Association at its present session.

Early in the month of December last I wrote to each member of the Committee asking for any information any of them might have on any subject likely to interest the Association, or to name any matter he wished to bring before this meeting. I have only had replies from three, none of whom had any suggestions to make or any information to impart.

We are glad of the fact that two exploratory surveys were undertaken last season by the Provincial Government. One, the continuation of the western boundary of the District of Nipissing north to the Arctic Ocean, by Mr. Niven, the other by Mr. Speight, commencing at the north-east angle of the Township of Hodgins, and ending on the main line of the Canadian Pacific Railway, about four miles from Dalton Station. In both of these surveys, especially that of Mr. Niven, no small amount of hardship was endured. But, as usual, the pluck, energy, and endurance of the party was equal to every difficulty and overcame every obstacle, and their cost a mere bagatelle for the amount of useful information thus obtained of a hitherto practically unknown section of country. And also as the lines have been well opened out, blazed, and durable mile-posts planted, they can be taken up at any given point, and used as a base from which future surveys can be made.

Your Committee hold fast to the motto that if a thing is worth doing at all it is worth doing well, and therefore submit that an exploratory survey is of as much importance and should be performed with as great a degree of care as any other.

We know that there are members of other professions who look upon surveyors as a very much overpaid class, and that the cash outlay on more than half the surveys ordered by our Government is simply cash wasted, and unfortunately many of our legislators are imbued with the same spirit. Your Committee take a strong and unanimous stand in opposition to any such teaching, and would urge that both surveyors and assistants be remunerated on a much more liberal scale for the dangers they encounter and the duties they perform.

In order to obtain his diploma a surveyor has to spend as many of the best years of his life, study as hard, be at as great an outlay, and pass as severe an examination as members of either the legal or medical profession; also quite as large an amount of brain power is necessary, and we think we are quite within the mark when we venture the assertion that the brain power in our profession is equal to that of either of the others.

We have all frequently been assured by some office gentlemen of what a happy time we must have—must is the word, there can be no doubt about its being the right one—away from all worldly cares. How they envied us our annual picnic, and how much they should like to share it. It has been our good fortune sometimes to take one or more of those gentlemen with us on our "outing." But, generally speaking, if they are within a reasonable distance of any well-defined route of travel, by some strange and unfortunate combination of circumstances they are seldom able to remain out to the close of the "pic-nic," and, what is still more remarkable, the party as a rule survives their departure.

In all the different paths of life we have always been assured that there is room at the top of the ladder. But there does not seem to be any top to the ladder in our profession. In the others we find gentlemen attaining both eminence and wealth in the course of a few years, while we surveyors have nothing more to look forward to than a paltry six or seven dollars per diem for about one-third of the year if we are so fortunate as to secure work from the Government each season. If not so engaged, the prospects are still more gloomy.

We would most earnestly and respectfully urge upon both the Government of our own Province of Ontario and also that of the Dominion the advantages that would accrue from the prosecution of a more thorough and extensive system of exploratory surveys in future than has ever been done in the past.

All of which is respectfully submitted,

JAMES DICKSON,
Chairman.

REPORT OF COMMITTEE ON REPOSITORY AND BIOGRAPHY, 1898 AND 1899.

MR. PRESIDENT.—Your Commitee have to report as follows: A large number of books, pamphlets, and maps have been added to our collection, and have been catalogued and arranged, which catalogue, together with a list of our reports and exchanges to date is attached to this report and will be printed in the Proceedings.

A welcome addition has been made to the furniture of the Repository in the shape of a step ladder, which was very necessary on account of the height of the windows from the ground; the table also has been newly covered.

A suggestion has been made that we exchange our present rooms for the three rooms, two of which are at present unoccupied, on the opposite side of the passage; the third, which is occupied by Mr. Southworth, would, the Secretary informs us, be readily

exchanged by him for our corresponding room.

Your Committee also made enquiries about a room in the top flat of the east wing, some years ago Mr. Tully having suggested that we should obain possession of it for draughting, etc. We found it not particularly suitable for that purpose, besides which the Survey Department object to the plans, etc., being taken so far from their offices; as a place for depositing our books, charts, etc., our present rooms in the basement are certainly preferable.

Little has been done during the past year towards collecting biographical sketches, photos, etc. We regret to say that the members of the profession seem too modest to respond to our appeals.

Mr. Unwin, a member of the Committee, has kindly consented to write some more reminiscenses. Your Committee would suggest that some other of the older members of the profession do likewise.

We have to acknowledge the presentation to our library by Mr. Tyrrell of his book, "Across the Sub-Arctics of Canada."

All of which is respectfully submitted.

H. L. ESTEN,
Chairman.

SUPPLEMENT TO CATALOGUE PUBLISHED IN REPORT OF 1897.

A.

Archives, Canadian, 1895, 1896, 1897.
Across the Sub-Arctics of Canada. Tyrrell.

B.

Bell, Dr., Nine pamphlets by.
British Columbia Board of Trade, 18th and 19th Reports.
British Columbia, Pamphlet on.
Boundary Survey, New York and Pennsylvania, 1886.
Bureau of Industries, Ontario, Report of, 1896.
Bureau of Mines, 5th, 6th (2 copies), and 7th Reports, 1895-6-7.
Bureau of Mines, Maps, 1896.
Baillairge, Charles, Biography of.
Bureau of Mines, Report of 1898, 2 vols. (except 3rd part of one).
Baillairge on Technical Education of the People.

C.

Cumberland Yard and Shops, Blue Print.
Canadian Almanac, 20 vols., ranging from 1850 to 1895.

Census of Canada, vols. 1, 2, 3, 4, and 5.
Coast and Geodetic Survey, United States, Reports 1891-2-3.
Compass, The, vol. 3, August, 1898, No. 1.
Colorado State Agricultural College, No. 45 and 48.
Costa Rica, Republic of.
Canada, Map of Dominion.
Civil Service Examiners, Reports of, 1883-85-86-87-88-89.
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DISCUSSION.

Mr. Van Nostrand—In connection with that step-ladder question, which has been revived, I think, for the third year, I beg to state that we have at last secured a step-ladder, at the expense of 45 cents. It was a very difficult matter to get one. We sent to Hamilton at last and got it, and had it sent here by special express. When it arrived it was appropriated by the Surveys Branch, and they had the audacity to put their mark on it. That has been erased, and I have since put the Association mark on it, and it is now in our possession.

Mr. Kirkpatrick—I would like to ask, has one surveyor the right to remove the marks of another surveyor ?

REPORT OF COMMITTEE ON TOPOGRAPHICAL SURVEYING.

MR. PRESIDENT,—Your Committee on Topographical Surveying beg to report as follows:

Although since the last report the inauguration of active work cannot be reported, yet matters of importance have taken place, and undoubtedly a beginning for triangulation or geodetic operations has been brought forward in a specific manner. The Committee refers to the paper by H. S. Pritchett, Superintendent of the U. S. Coast and Geodetic Survey, on "A Plan for International Measurement of an Arc of the 98th Meridian," read before the Royal Society of Canada, May 27th, 1898, a copy of which, with his accompanying charts, is herewith submitted, to be incorporated with this report.

Your Chairman was present at the reading of the paper, and took part in the discussion; he also presented a copy of the Memorandum prepared by the Committee of the Dominion Land Surveyors' Association in 1888, on the general scheme of a "Trigonometrical Survey of the Dominion," and read extracts of letters to him from Dr. Gill, Astronomer Royal at the Cape, earnestly advocating the latter.

The reading and discussion of Dr. Pritchett's paper was followed by a memorial from the Royal Society to the Federal Government supporting the scheme, to which the Mexican Government has already given its support.

You will notice that the 98th meridian has been chosen on account of its great length on land, and, therefore, available for measurement.

In our country it passes a little west of Winnipeg, through Lake Winnipeg and on towards King William's Land, in the Arctic, together about 750 miles.

From the geographical position of this meridian, it will be seen that its utilization for our practical purposes is rather circumscribed, and a prolongation of the oblique arc along the Atlantic, extending to our borders, through New Brunswick, Nova Scotia, and Cape Breton, would serve more useful purposes for land surveys and accurate delineation of topographical features there than that offered by the 98th meridian. However, the latter as an international work, and one of the highest importance from a scientific point of view, deserves our hearty support, and we should take pride in taking part for the first time in an undertaking of such import, toward which every civilized and progressive nation of the world has bent her energies in some way.

It must be impressed that the inauguration of this work is a serious undertaking, for the work, in order to be valuable, must be done as well as can be done anywhere, otherwise its value will be comparatively useless for the object in view. Experienced men for such work we have not many, and we would necessarily have "to feel our way."

However, if the measurement along the 98th meridian is inaugurated, the scheme for a general triangulation of the Dominion would necessarily and undoubtedly follow.

For this reason, too, we think that the support of the Association should be extended for the international measurement of this meridian, and formally presented to the Dominion Government.

All of which is respectfully submitted.

OTTO J. KLOTZ, Chairman.

February 27, 1899.

The necessity for a careful and accurate triangulation of any country, as the basis of a systematic survey, is so well established, and the expense involved in such work so well justified on utilitarian grounds, that no defence for such expenditure on the part of any civilized country is now needed.

The large systems of triangulation, which have been constructed by different countries, have usually been designed as the bases of systematic surveys. Their employment in the determination of an arc, either of a meridian or of a parallel of latitude, has been ordinarily a secondary consideration, but the value of the data furnished by such triangulation schemes, for the final solution of the problem of the earth's spheroid, are of such high interest, that most nations have been glad to shape their plans for triangulation in such a way as to accomplish the latter end as well as the former. The necessity for an accurate triangulation across Canada, as the basis of a systematic map of the country, needs no argument from me, but I gladly avail myself of this opportunity to call to the attention of the Royal Society a plan by which, not only the utilitarian object of a primary triangulation may be secured, but also, a plan by which, through the co-operation of the three Governments in North America, an international geodetic work, of the highest value to this continent and to the world, may be carried out.

The size and shape of the earth may be found, either from two meridional arcs or two longitudinal arcs, or from a single oblique arc. The first method was exclusively employed during the last century, because it was possible to determine latitudes with far greater precision than longitudes; but, in recent times, the electric telegraph has so simplified the determination of longitudes, that the last two methods may now be applied with entire success.

All three are comparatively simple in their theory, although the problem, considered in detail, becomes an intricate and difficult one.

The process in each case is as follows:—For the first case, we have only to measure the length of two lines running north and south, and observe the latitudes of the extremities. From this data, the flattening is first found, and afterwards the absolute length of the axis. This method was that used up to the present time, and our knowledge of the figure of the earth, and of the constants of the spheroid, depends wholly on measurements of such arcs of the meridian.

The second case, that of determining the earth's figure by means of longitudinal arcs, is rapidly coming into use, on account of the application of electricity to the determination of longitudes. The fundamental idea, like the preceding one, is simple. We measure the distance between two points lying nearly, or exactly, east and west, determine their longitudes, and, also, their reciprocal directions. The latitudes need not be accurate when the observations are near the equator, and when the line is nearly east and west the azimuths do not need to be accurately known. A second arc gives similar relations, and by means of both we can determine the earth's compression and its absolute size.

A third way of getting at the constants of the spheroid is by an oblique arc, such as has just been completed in the United States, between the northern part of Maine and the southern part of Alabama. Here we have a case, where the directions between the extreme points are of much greater importance than in the last method. As usual, the latitude of the extreme points must be found, and with this data, and the reciprocal azimuths, the flattening of the earth may be deduced. The simple addition of the length of the line joining the two points, enables us also to find the size of the earth, and thus completely determine the figure. It is evident that the method is not applicable, when the line is nearly north and south, or east and west, or when the work lies near the equator. The most favorable conditions are when the arc is quite oblique to the meridian, and above middle latitudes.

Two discussions of the form and size of the earth are in use in geodesy, and both depend entirely on the results obtained of measures and arcs of the meridian. The first of these is that obtained by Bessel, in 1841, from ten small arcs, whose aggregate length amounted to 50.6 degrees. This discussion gave an equatorial value of the radius of 6,377,397 meters, and a polar semi-axis of 6,356,079 meters, and a value of the compression of 1-299.15. The arcs employed in the discussion are all short, and are now considered of little importance. The result, however, was by far the most correct up to this time, and was accepted universally among scientific men until the discussion of Colonel Clarke in 1866. From

PRINCIPAL ARCS OF THE MERIDIAN. THE PARALLEL AND OBLIQUE ARCS

FOR THE MEASUREMENT OF THE EARTH'S FIGURE AND SIZE

FIG. 1.

a combination of five arcs, having an aggregate length of 76.5 degrees, he deduced an equatorial radius of 6,378,206 meters, and a polar semi-axis of 6,356,584 meters, giving a compression of 1-294.98. The arcs included in this result were the English, the Indian, the Russian, the Cape, and the Peruvian arcs. In 1880, Colonel Clarke published another discussion of the problem of the earth's figure from a discussion of six arcs, whose aggregate length was 81.7 degrees, from which he deduced values slightly different from those just given. From the homolographic projection which accompanies this paper, the meagreness of the data is at once evident. See fig. 1.

I beg now to call your attention to two arcs which have been completed in the United States by the Coast and Geodetic Survey, and which, with the exception of the Peruvian arc, and a few small arcs measured years ago in the United States and of but little value, constitute the first important contributions to the determination of the figure of the earth made in the western hemisphere. The first of these is an oblique arc, extending from Calais, Me., to Mobile, Ala., a distance of 22.1 degrees, or 1,525 statute miles. The number of principal triangulation stations is 172, and the number of base lines 6; 61 latitudes, 48 azimuths and 14 longitudes, all telegraphic, constitute the astronomical data for the discussion. The ease with which this arc could be extended from the Canadian border to Cape Breton is evident at once, from an inspection of the map of the region. This extension would increase the length of the arc about 5 deg., and would, at the same time, form an admirable foundation for a trigonometric survey of the Maritime Provinces.

The second arc is that which is just nearing completion, an arc of the parallel in latitude 39 deg. The character of the triangulation throughout the extent of this arc varies greatly, on account of the difference in the character of the country. The terminal points of the arc are Cape May, N.J., and Point Arena, Cal. The length of the arc measured on the parallel is 48 deg. 46 min., equal to 2620 statute miles. The number of base lines is 10, the length of the shortest being 2.4 statute miles, and of the longest 7.9 statute miles, or an average of 5.3 miles. The average number of conditional equations, subsisting in the triangles of the base net, is between 20 and 21. A number of different kinds of apparatus were employed in the base measures. They all depend on the committee meter as the unit of length. This iron meter is one of the original standards introduced by the French committee in 1879, compared at different times and by different means.

The distance between adjacent base lines varies from 108 miles to 531 miles. This long chain of triangles is characteristic, as compared with similar undertakings, by its strength of composition.

The chain consists of quadrilaterals, central figures, or other strong combinations of triangles. The size of the triangles, where they cross the central valley is of necessity of ordinary character; but in crossing the Rocky Mountains their utmost development has been reached. The longest side of a triangle, from Mount Ellen to Uncompaghre, was 182.1 statute miles. The highest trigonometric station was 14,300 feet, and the spherical excess of the adjusted triangle was 73.8 seconds, the triangle having an area of 5,000 square miles. The observation of this gigantic arc was begun 27 years ago, and the last observations which remain to complete the work are now in progress. They will be finished during the present summer, and as the discussion of this vast amount of material is already well advanced, it seems possible that we shall have the results of the completed work ready for publication within the next eighteen months. A preliminary discussion of these results points to certain interesting conclusions relative to the form of the ellipsoid which will best represent this portion of the globe.

The results of the discussion point in the same direction with the preliminary discussion of the arc of the 52nd parallel in Europe, namely, that the curvature is greater than would be required in an oblate spheroid of the dimensions of our earth.

Without, however, attempting to give in detail these preliminary results, I beg to call your attention to the inauguration of the measurement of an arc of the 98th meridian, which has already been begun in the United States, and which, if it could be extended along its whole length throughout Canada and Mexico, would make by far the longest arc of the meridian which has ever been measured, and would, taken in connection with the arc of the parallel, and the arc which I have just mentioned, give data for a most excellent definitive discussion of the spheroid which would best fit the continent of North America. This arc, as is seen from the attached sketch, extends throughout the United States, north and south, and from the southern limit of Canada to the Frozen ocean, and from the southern limit of the United States to the Pacific at Acapulco. The southern end of the arc is in latitude 17 deg., and the northern limit of the arc may very well be extended to 67 deg., making a total length of 50 deg. The longest arcs of the meridian heretofore measured are the following:

The Anglo-French arc	22 deg.	10 min.
The Russian arc	25 "	20 "
The Indian arc	23 "	49 "

It will thus be seen that the arc here proposed is double the longest arc of the meridian which has up to this time been measured. The value of this arc, as compared to the part lying in the United States, alone would be enormous. Dr. Gill has called atten-

PRINCIPAL ARCS MEASURED AND IN PROGRESS ON THE CONTINENT OF NORTH AMERICA

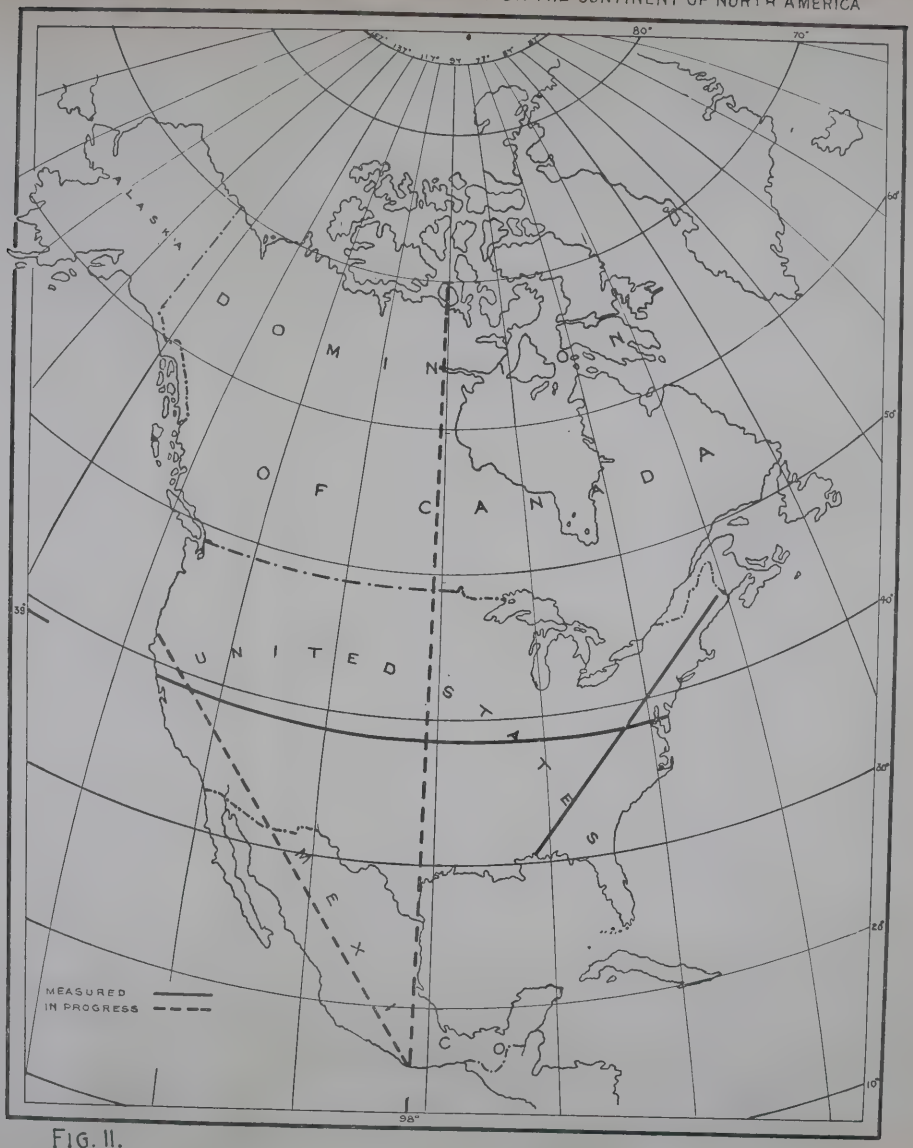


FIG. 11.

tion, in the report on the Geodetic Survey of South Africa, 1883-1892, pp. 157-159, to the great advantages to geodesy, which accrue from the measurement of long arcs.

The length of the arc in the three countries is as follows: In Canada, to latitude 67 deg., 760 miles; in the United States, 1,590 miles; and in Mexico, 690 miles; in all, 3,040 miles. The character of the country through which the triangulation would need to be carried is such that it would be comparatively inexpensive, unless in Canada the forests should add to the expense. A very close estimate of the cost of this work can be gained from the cost of similar work in the measurement of the 39th parallel, since more than a thousand miles of this arc passed through a region which was entirely similar to that contained in the arc of the 98th meridian. I find, after a careful investigation, that the entire cost of this work, including salaries, expenses of travel, instruments, and erection of signals, subsistence of parties, and all expenses connected with the work, was at the rate of $120 a mile. At the present time it could doubtless be done for less; probably at the rate of $100 a mile. The sides of the triangles would be from ten to thirty miles, and the work would be in every way analogus to that which has already been carried on along the 39th parallel, through the States of Indiana, Illinois, Missouri, Kansas, and portions of Colorado. Part of this line, at the time when the observations were made, was heavily wooded; and required the cutting out of long and expensive lines, the removal of obstructions, and the building of signals, which made that work quite as expensive, if not more so, than the work of the 98th meridian would be. At this estimate, the cost to the three countries would be as follows: To Canada, $76,000; to the United States, $159,000; and to Mexico, $69,000. The rapidity with which this work could be carried out, would depend on the number of parties that can be put in the field. It is expected that the part of the triangulation lying in the United States will be finished in from six to eight years.

Without going into any longer discussion of this matter, one may say, briefly, that the completion of this measurement of the 98th meridian would, combined with the measurement of the 39th parallel already completed, make an epoch in our knowledge of the earth's figure and size, and would furnish data which could probably never be improved upon, so far as the North American continent is concerned. See fig. 2.

In suggesting this co-operation in a great international work, it seems fitting to call attention to the history of the International Geodetic Association for the measurement of the earth. The first plan for co-operation in geodetic measurements on a large scale seems to have come from General Bayer. In 1861 he wrote to the Prussian Minister of War recommending that the nations of

middle Europe should combine forces, and devote themselves to the solution of this problem; and calling attention to the fact that France had undertaken the work on a large scale in the eighteenth century, England and Russia in the nineteenth, and that the eastern and western parts of the continent were much farther advanced in this work than his own country. At this time only three arcs of the meridian had been measured in Europe, and the anomalies in the deflection of the plumb line had not been explained. The first and most natural proposition was that these anomalies were due to the attraction of the mountains, but when deflections of the plumb line were found on extended plains, and when, as they then supposed, the great Himilayas exercised no appreciable effect, they were led to suppose great changes of density in the earth's surface. Perhaps this phase of the question stimulated, as much as anything else, the co-operation of the different Governments; and in October, 1864, there was effected an organization for the measurement of arcs in middle Europe. Nineteen States gave support to the project. This general plan remained unchanged until 1887, when the middle European association was merged into an international one, and nations from all parts of the world became parties to the convention. The organization was continued for a period of ten years. In 1806 new powers were assumed by the organization, and a new convention to last for ten years, or until 1906, was drawn up. The following countries have joined this convention:

Germany,	Spain,	Japan,	Roumania,
Austria-Hungary,	United States,	Mexico,	Russia,
Belgium,	France,	Norway,	Servia,
Chile,	Greece,	Holland,	Sweden,
Denmark,	Italy,	Portugal,	Switzerland,

It is with very great pleasure that I am able to add that, within the last month, Great Britain has also given her adherence to this convention, and has named as delegate and representative on the permanent committee Professor George Darwin.

This is, in brief, the origin and growth of the present international organization. An outline of the methods of the work, and the results attained, will show what is being done by concerted national action to determine the size and the figure of the earth. From the beginning of the work up to 1887, the results were largely of local importance. Each State Government reported on the operations within its borders, and which were intended primarily to serve as bases of maps for the various countries. The triangulation, measure of base lines, astronomical observations, precise levels, and tidal observations, found their greatest use locally, but in the last ten years questions have been taken up which are of the greatest interest to each individual country, and to the world as a whole.

As illustrating the methods which are now being pursued, I may mention that the last undertaking on the part of the International Geodetic Association contemplates a final and definite solution of the variation of latitude. The association proposes to establish four stations, as nearly as possible at equal distances around the earth, and all within half a mile of the same parallel of latitude. The character of latitude variation from season to season is now comparatively well known, and the fact that we are sixty feet nearer the equator at one season of the year than at another no longer appears startling, but the results so far have been to a certain extent vitiated by the fact that the star places are uncertain; and although by an ingenious method of combining the observations this defect to a large extent disappeared, nevertheless the observations do not yield the desired precision. The method proposed by the International Association, and now in progress of being put into practice, will be free of any errors in the accepted position or proper motions of the stars. This can be accomplished by locating the points on the same parallel of latitude, and as nearly as possible equally distant. Four stations have been chosen, all on the parallel of 39 deg. 8 min. Two stations are taken in the United States, one on the Atlantic coast, and one on the Pacific coast; one station in Japan, and one in Italy. At the present time, a most careful examination of the topography of the various regions in which stations are to be established is being made, in order that all the conditions may be comparable and well determined. It is proposed to carry on latitude observations with precision at these four stations, for a period of seven, possibly ten, years; at the end of which time sufficient data will be at hand to predict the position of the pole with all the precision necessary for the most refined astronomical calculations for at least a century to come.

The result of this international effort at co-operation seems so striking, and the ends to be accomplished are so well worthy the efforts of the best thought and the best energy of any nation, that it seems a fitting example to encourage an effort of similar co-operation among the nations of the North American continent.

NOTE.—Since this paper was read, the Government of Mexico has announced, through the Secretary of the Interior, its readiness to undertake its part of the work here proposed.

[COPY.]

To His Excellency the Governor in Council, etc.:

The Royal Society of Canada has the honor to bring to the notice of Your Excellency a proposal by Dr. Pritchett, Superintendent of the United States Coast and Geodetic Survey, to measure an arc along the 98th meridian from Acapulco, Mexico, to the

shore of the Arctic Sea in Canada. Dr. Pritchett's views are explained in a paper read by him at the last meeting of the Society. A copy of this paper, with explanatory maps, is appended.

The measurement of the 98th meridian has been in progress for some time as part of the general survey of the United States. The object of Dr. Pritchett in urging its extension through Canada and Mexico is to provide data for the determination of the figure and dimensions of the earth and while from this point of view the work would be purely scientific, the Canadian portion of it would also be of great practical utility in forming the basis of a thorough geographical survey for this Dominion.

While it is true that the promotion of science is mainly due to a few of the most advanced and wealthy nations and that these nations have frequently sent expeditions, or established stations abroad when information had to be obtained in semi-civilized or wild and uninhabited countries, it is also a fact that the least favored of the civilized nations have not unfrequently assumed the task of assisting science to the extent of collecting data obtainable within their own borders.

In the present instance the survey is in progress within the limits of the United States and quite recently the Government of Mexico has announced its readiness to undertake its part of the work. The successful execution of the project as a whole, therefore, now entirely depends on the co-operation of Canada. It is respectfully suggested, therefore, that a limited grant for this purpose would be regarded as a contribution to aid in the general researches of the nations of the world, while at the same time it would serve to inaugurate a very much needed work and one of great practical importance to the future of the Dominion.

Extensive triangulations have seldom been undertaken upon scientific grounds alone; their primary object has been utilitarian and to provide a basis for systematic surveys. Without such a basis there is no finality in results; the same ground is being surveyed over and over again, as is the case in the Dominion, by the land surveyor, the geologist, the railway and canal engineer, the hydrographer. For every new project a new survey has to be made. The labour and expenditure on these surveys would be considerably reduced and often entirely unnecessary if we had a systematic triangulation carried out as in other countries. This fact has long been recognized in Europe, where every country has been accurately mapped. Outside of Europe may be cited the United States, whose triangulation is well advanced; India, which offers a striking instance of extensive and well conducted surveys; the Cape of Good Hope and Natal, which have executed a joint triangulation of South Africa; New Zealand, where triangulation has preceded all other surveys. It must not be supposed that there were

no objections raised in these countries to the inception of the work; on the contrary, it was frequently opposed by those who did not understand its practical value, but their opinions changed after they had been in a position to appreciate its usefulness. Of the survey of South Africa, Mr. David Gill, Her Majesty's Astronomer at the Cape, says:

"The influence of the geodetic survey has made itself felt by raising the whole tone of survey operations in South Africa. Strongly as it was at first opposed and grudgingly as it was maintained, its advantages are now fully acknowledged, and by none more warmly than the Surveyor-Generals of the Cape Colony and Bechuanaland."

The triangulation of the 98th meridian would be for Canada the first step in the right direction, to be followed by others, as the resources of the country would allow. It is believed that an appropriation of say $10,000 for a few years would be sufficient to carry to completion the measurement of the 98th meridian. The Royal Society of Canada strongly recommends such a grant, and believes that the work will be of great benefit to Canada, not only by its immediate practical results, but also in placing the country in a more favorable light before the scientific world.

And your memorialists humbly pray that Your Excellency will take the foregoing facts into your favorable consideration.

REPORT OF COMMITTEE ON DRAINAGE.

MR. PRESIDENT,—Your Committee on Drainage begs to report as follows:

Some members of this committee do not appear to take any interest in its report, and neither attend the annual meeting of the Association nor even take time to write a letter on what they know or don't know about drainage; others write to say that they have been engaged on work other than drainage, and refer the chairman to members further west for information. From this one might reasonably suppose that very little work was now being done under "The Municipal Drainage Act," or "The Ditches and Watercourses Act," or that these Acts were now so well perfected that no further changes in them were required, and that they were expressed in language so clear and precise that all would interpret and apply them in a uniform manner. At the last session of the Ontario Legislature no amendments were made to these two Acts, but a slight amendment was made to the Municipal Act referring to drainage debentures. Though this is a little out of the usual

course of events, the fact appears to be that the work of drainage construction and repair is going on about as usual, and the lawyers and judges are called in as heretofore to see that justice is done. Judging from the reported cases the amount of litigation keeps well up to the average of former years. The great questions of "benefit," "injuring liability," and "outlet" are still to the fore, as well as innumerable other details, which have been gone over and decided by the Courts in more ways than one. Still, your committee does not think it can make a better use of the time at its disposal than to call attention to a few of the points on which decisions have been given:

1. With regard to the "petition" required by sub-section 1 of section 3 of the Municipal Drainage Act. The decision of Drainage Referee Britton, in the case of Malahide vs. Dereham, brings out clearly the fact that the petition must define the area to be drained and be signed by the majority of owners of lands in the initiating township to be benefited. The following is quoted from his report dated February 14th, 1895:

"Again the petition is not for the draining of any area described in the petition. It is simply a petition for the survey of a proposed drain which the petitioners want, and to have plans and specifications, with estimates of the proposed work to be done under the provisions of the Municipal Drainage Act, the drain to commence at the south half of lot 28, in the 11th concession of Dereham, to cross certain lots in Dereham, to enter Malahide and cross certain lots in that township, and to terminate in the Catfish Marsh drain in the township of Malahide. This is not for the drainage of any particular area in Dereham. It is something persons in Dereham and Malahide wish to have done, but it does not give authority to Dereham to have it done and assess lands in other townships for its cost.

"When the township of Dereham undertakes to assess lands in Malahide, the onus is upon Dereham of showing very clearly the legal right to do so.

"The petition to that township in this case does not purport to be signed by the majority in number (exclusive of farmers' sons not actual owners), as shown by the last revised assessment roll to be the owners of the lands to be benefited in any described area within the township of Dereham. It was not shown that the petition was in fact so signed by such majority. The assessment roll was not produced.

"Looking at what was in evidence before me, this petition was not so signed."

In the report of Referee Britton on the case of Gosfield South vs. Mersea, which came before him in February, 1895, we find that the Council of Mersea acted on a petition which asked that lots

11 and 12, concession A, be drained by means of a drain through said lots sufficient to relieve said lots from injury caused by waters brought down upon them from the higher lands to the north and east. The engineer reported a work that would cost $1,026, and assessed the said lots 11 and 12 the sum of $42 in all, as follows: For benefit, $20; for outlet liability, $10; and for injuring liability, $12. In the two lots mentioned there was an area of about 35 acres liable to be flooded.

The Referee discusses the petition as follows:

"Again what was asked for in this petition was not what was really contemplated by section 3, sub-section 1. That provides for lands useless, or comparatively useless, by reason of surface water naturally upon it. Such lands may be benefited, first, by the construction of a drain; second, by the improving of a stream, creek, or watercourse as therein stated; or, third, by the lowering of the water of a lake or pond, or by all of these together.

"This petition, although the first part of it is in the form prescribed by section 4 asks for a drain to relieve lots 11 and 12 from injury, caused by water brought down upon them from the higher lands to the north and east by the drains constructed in what is known as Sturgeon Creek and Coulson drain and other drains. The Council cannot do such a work merely because it is petitioned for."

2. With regard to "benefit," the following extracts from the Referee's report on the above case of Gosfield South vs. Mersea will aid us in considering it:

"Whenever a case occurs where the work to benefit petitioners cannot be done except at a cost far in excess of the benefit directly upon, and by furnishing an improved outlet for any and all lands assessed, such work ought not to be proceeded with merely for the sake of benefit.

It may be answered, that is a matter of judgment and discretion to be exercised by the Council, and, if such is within the statute, the referee has no jurisdiction to prevent it. I am of opinion that the referee has jurisdiction and should deal with it on an appeal by another municipality.

"There was no attempt to ascertain the amount for which lots 11 and 12 should be assessed for benefit, and that was necessary whatever meaning may be attached to the word "benefit." Mr. McGeorge, an engineer of large experience, says he would first ascertain what the assessment should be for benefit, and that, in his opinion, would be the amount required to take away the water that runs upon these lots 11 and 12 in a state of nature. He does not think that benefit means all the advantage that is to accrue to land by reason of taking the surface water away."

3. With regard to "injuring liability," the Referee discusses it as follows in the above case of Gosfield South vs. Mersea:

"The Council may, as authorized by sub-section 3 of section 3, under certain circumstances and in a proper case, without any petition proceed with the construction of a drainage work required for relieving lands and roads injured by water caused to flow upon them. An engineer's report would be necessary, but that report would be different from the present. The engineer would require to determine under what circumstances such water was caused to flow upon and injure. It is not merely a question of water being brought down from higher lands to lower, waters that might come without any drainage work, but it is to be determined what water by any means by man employed, is caused from lands and roads to flow upon and injure other lands and roads where no compensation has been paid, and no corresponding benefit conferred, and having ascertained that to assess and charge the lands from which water was caused to flow and injure, for the construction and maintenance of the drainage work necessary for the relief of the injured lands and to the extent of the cost of such work."

In Referee Britton's report in re Tilbury North vs. Romney, we find the following paragraph:

"The counsel for respondent township contends that under sub-section 3 of section 3 the engineer's report can be upheld. I do not think so. I do not think sub-section 3 of section 3 applies to such a case as this at all. That sub-section applies, as it seems to me, where in doing a work under sub-section 1, or where a work has been done under that sub-section, water is caused to flow from the lands or roads of such municipality, company or individual, upon and injure lands or roads of any other municipality, company or individual, then the lands and roads from which water is so caused to flow may be assessed and charged for the construction of the drainage works, for relieving the injured lands or roads from such water, and to the extent of the cost of the work necessary for such relief."

In the appeal of the townships of Caradoc and Metcalfe from the judgment of the Drainage Referee, given in favor of Ekfrid, the judgment of the Referee was reversed and Osler, J.A., in stating his conclusions (November 9th, 1897), refers to "injuring liability" as follows:

"Assessment for relief from injuring liability seems to be the same thing as assessment for what is defined, or rather described, as 'injuring liability' in sub-section 3 of section 3, viz.: the assessment of 'lands from which water is 'by any means caused to flow upon and injure' other lands: the assessment being for the cost of the drainage work necessary for relieving the injured lands from such water."

4. We will now consider some references relating to "outlet liability." In the above case of Caradoc and Ekfrid, Osler, J.A., discusses it in part as follows:

"Now, the lands in Caradoc which have been assessed by the engineer already had an outlet by means of Government Drain Number One, so far as they were directly or intermediately drained through it. The great bulk of these lands needed no other outlet than that which they already had. Their lands lay high and the drainage they already had was sufficient for them. For that work they had already paid, and what they are now charged for is a new work not giving them any new outlet. It is plain from the evidence of the engineer that, so far as they are concerned, the work does not give them an improved outlet. I speak now of the great bulk of the property assessed, for there may be cases of a few lots along the course of the drain, the outlet of which is improved, or which are distinctly benefited by the new work. What I regard as objectionable in the principle which the engineer seems to have adopted is this, that to use his own language, he has taxed the lands because they contribute water to the area drained, charging lands within that area with outlet expenses, no matter how remote they are, and although the new work, or perhaps the drain itself, is not necessary for the cultivation or drainage of the land.

Unless the work when constructed would provide an improved outlet for the lands in Caradoc directly, or as under the new Act may perhaps now be the case, indirectly, I cannot see what power the engineer had to assess them for such work, and this affects so large a proportion of the sum charged against that township that it appears to me the Referee should have given effect to Caradoc's appeal, and overruled the report of the engineer."

Drainage Referee Thomas Hodgins, in an oral decision given on the 8th of October, 1898, in re Wainfleet and Moulton, is reported in part as follows:

"The two grounds on which this assessment must be set aside were decided by the Court of Appeal some years ago in re Orford and Howard, 18 A. R., 496. First, as to the meaning of the term "outlet," and how an assessment for it should be borne, the observations of Osler, J. A., may be referred to: "The object was to prevent one municipality from taking advantage of a drain then already, i.e., at the time the Act was passed, or thereafter constructed by another municipality, without contributing to the cost. Every drain into which another drain is made to flow is an outlet or is used as an outlet for it; and unless the application of the section is limited to a case of that kind, which comes within its express words, the whole of a multitude of drainage areas may be taxed for outlet purposes for as many as exist between the watershed and the point where the waters of all are ultimately discharged.

The language of the section in the two cases it provides for, points to a direct and intentional user of a particular drain, or of causing water to flow upon and injure defined or definable lands. In the one case the municipality which uses the constructed drain of another merely as an outlet may be assessed for a proportionate share of the cost of the construction of the drain so used."

Referee Hodgins then continues:

"It may be laid down as a general proposition that when a drain has to be made larger than is required for the drainage of the adjoining lands because of its having to carry off the waters coming from the drains of higher lands, such higher lands should bear a proportion of the cost of such larger drain.

"The other point on which I referred the report back to the engineer was because he had assessed the entire scheme substantially for outlet; that under the statute was not correct, for in the same case of Orford and Howard Osler, J. A., says: 'The assessment being single (for outlet), in respect of one entire scheme, but made up partly for benefit, partly for outlet, and partly for relieving lands injured by water cast upon them by Orford, and no distinction being made as to lots assessed for benefit, injury, or outlet, I think the whole must fail."

The explanations of various points in the Drainage Act given by the judges throw considerable light on the principles governing the assessment of lands, but a study of the decisions given serves to show that work under its provisions must be undertaken with the greatest care, and even after a careful study of the sections of the Act the most experienced may have his report "set aside."

Some proposed amendments to the Municipal Drainage Act, of considerable importance, serving to elucidate its meaning or facilitate its working have been sent in and are appended hereto for your consideration.

All of which is respectfully submitted.

GEORGE ROSS,
Chairman.

QUESTION DRAWER.

Question 1.—Can lands of railway companies be assessed and charged for the construction and maintenance of drainage work done under "The Municipal Drainage Act"?

Answer.—This seems to be a disputed question, and railway companies having a Dominion charter sometimes refuse to pay their assessment, but there is little doubt that they are liable under

the Act. Referee Britton, in re Caradoc and Ekfrid, refers to it as follows: "The omission of the lands of the railway companies, if objectionable, is for the Court of Revision. In so stating I am not expressing an opinion as to whether railways under Dominion charter are subject to the drainage laws of Ontario or not.

Question 2.—Can a municipality be compelled to undertake the construction of a drain or the deepening and widening of a drain or creek for the relief of certain lands, under sub-section 3 of section 3, of the said Act, when the petition required by sub-section 1 of said section has not been presented to the Council of said municipality ?

Answer.—Such work as is authorized by section 75 can be done without a petition. The Council might be "compelled" to proceed with the necessary drainage work by an action for damages.

Question 3.—Can a Municipal Council take steps under said Act without a petition for the construction of any drainage work, and if so can the lands benefited by said work be assessed and charged for the same as provided in the Act for work done under petition ?

Answer.—Only as provided for under section 75.

PROPOSED AMENDMENTS TO DRAINAGE ACT.

With regard to the report of the Drainage Committee, I might suggest a few changes in the Drainage Act to facilitate the working of the Act.

First, with regard to bridges between the travelled portion of the highway and the lands of private owners.

Under the provisions of the Act as per advice from solicitors experienced in drainage matters, the Municipal Council initiating or undertaking the work must build those bridges, and funds must be provided for construction as well as a fund for maintenance of such. This would, perhaps, lead to difficulty and perhaps litigation between the owner and the Municipal Council, and it is difficult to state just what is a proper bridge, and in case of accident owing to non-repair the Municipal Council would perhaps be held liable for damages. Unless the owners agreed to accept the sum set apart in the estimates or a sum sufficient for the purpose, the Councils of flat and level townships would have enormous difficulty in maintaining the bridges. Again, there is considerable dispute as to whether an engineer must provide for maintenance of bridges on drains constructed before 1894, as before one can have maintenance the drain must be constructed, and "construction" under the Act means the original opening of work, and it is held by a member of

the Drainage Commission that it was not the intention to frame the section so as to provide for maintenance of drains already constructed, but only of drains to be constructed after 1894.

This would give two sets of drains—one constructed before 1894, on which the engineer should not allow for maintenance of bridges; and the other, drains constructed after 1894, on which he must provide for maintenance. A very complicated state in drainage. I would suggest that this section be amended so that a sum be paid to the owner instead of the Municipal Council constructing and maintaining same, and that the amount be subject to the same rights of appeal as an assessment on lands. Also, that the section be so worded as to render clear what bridges the maintenance of which is to be provided for.

Second. With regard to section 84 of the Drainage Act, whereby Award Drains are made Municipal.

When an award drain lies in two townships and the parties of the upper township wishes to municipalize the award, the petitioners in any described area in the initiating municipality must possess as well the majority of persons interested in the award in both townships.

This would render the municipalizing of the award more difficult than the initiation of a new drain which in all justice should not be the case. I would suggest that the change be made to "the majority of the persons interested in such award in the initiating township.

A. S. CODE,
Member of Commitee on Drainage.

DISCUSSION.

Mr. Bowman—Those decisions regarding the different kinds of assessments will be invaluable. I would like to ask if any of the members have had any experience in applying the Municipal Drainage Act in towns for the construction of storm water sewers. In Berlin there is a petition for a large storm water sewer under the Municipal Drainage Act, requiring these troublesome assessments to be made on a fifth of an acre lot, and it seems to me a pretty big undertaking, as there is about 300 acres in the drainage area. Has any gentleman present had experience in preparing these assessments?

Mr. Morris—I had a case of a small area to be drained. The application was under the Ditches and Watercourses Act. It was

found the only possible way to get rid of the water was to go through a village. On reading the Ditches and Watercourses Act, my own opinion was that it was never intended to cover expensive storm water drainage; that it was impossible to act under that; so we got legal advice on the question, and the opinion was that we could not use the Drainage Act to get rid of the water; it was never intended that storm water drainage should be by means of assessment—that is, under the Municipal Act, no assessment could be put in in that way except by means of petition, local improvement. I thought I would go for better advice, and I got the advice of a gentleman retired from the profession of the law, who had a good deal to do with that class of work, and his opinion was he did not think there was any legal way whatever to get rid of the water—that is, to build an expensive sewer. He recommended me to refer back the report for a new award. I understand there are a number of applications endeavoring to make the Drainage Act and the Municipal Act do what it was intended that the Ditches and Watercourses Act should do—that is, the drainage of surrounding lands in the outskirts of small municipalities. And I think it possible there might be some amendment probably to the Drainage Act that might include cases of that kind, not under the Municipal Act at all, but under the Drainage Act.

Mr. Van Buskirk—I took a case to a solicitor. We wanted to put in a storm sewer. The trouble is that the sanitary sewer is already in and assessments have been made for that. The solicitor's opinion was that it could not be put in under the local improvement clauses of the Municipal Act, without petition, and it could not be put in under the drainage clauses of the Municipal Act without petition, and it is impossible to get a petition for either one of them, so I concluded to advise the Council to pay for it out of the general fund. To submit a by-law to the people raising money to do so under the present state of the law is the only way I see of doing it. There ought to be some amendment to the local improvement clauses of the Municipal Act empowering us to put in storm sewers.

Mr. Bowman—On what grounds did the solicitor rule that you could not put in a storm water sewer under the Drainage Act? We know previous to 1894 the Drainage Act and the Municipal Act were all mixed up together.

Mr. Van Buskirk—He did not say we could not. It could not be done without petition. He said it might be done.

Mr. Bowman—To make it under the Municipal Drainage Act you have to have a petition of the majority of the owners benefited in any described area. But it seems to me it is perfectly applicable

to one municipality at least, and if you can go from one township to another why cannot you go from a town or a village to include lands outside of the corporation in the township.

Mr. Morris—The difficulty was we were unable to get a petition. Parties not interested did not want the storm water sewer and yet if it was constructed at the expense of those who were anxious to have it the others would get the benefit. They were draining into it and were not paying for it.

Mr. Ross—I think if you get the majority of the certain section that was to be benefitted, they could put in the drain, and could assess other parties directly benefitted for improved outlet only. With regard to the Local Improvement Act you can only assess parties that are directly benefitted. You cannot assess for outlet at all. That is the trouble with the Municipal Act under which local improvements generally come.

REPORT OF COMMITTEE ON LAND SURVEYING.

Mr. President.—Your Committee beg to report that so far as they have been able to ascertain Land Surveyors in the Province have had a fairly successful year.

Several members have reported that the amendments of 1897 to the Survey Act have given general satisfaction, especially the running of lines on the astronomic course in the Huron and Ottawa territory.

The Committee are pleased to note that the Council have been successful in putting a stop to illegal practice in different parts of the country, and this must prove of great service to surveyors in the newer parts of the country and throughout the mining districts.

The Committee are also pleased to note that the Engineers' Bill for incorporation, now before the Legislature, is receiving the attention of the Association.

A number of questions in surveying have been sent in. These, with replies, are appended hereto.

All of which is respectfully submitted.

A. Niven, Chairman.

March 1st, 1899.

QUESTION DRAWER.

Question 1.—On what bearing should the line between lots 20 and 21 be run? The lines between lots are not shown in notes of original survey (which was a traverse of Longwood's Road), except the line between lots 13 and 14, which was run as shown on plan. The original plan gives the bearing N. 16 deg. W. mag. to the line between lots 17 and 18, which was evidently intended for governing line. Mag. var. 0° 45'. Longwood's Road is not on our course.

Answer.—Run at angle 27 deg. 45 min. with line between lots 13 and 14. (Sec. 25, cap. 181).

Question 2.—In this case the front line of the last 6 lots of con. 3 is entirely obliterated, and no points in front of said lots can be obtained by evidence as to the original line eastward from the south-west angle of lot 19. The Council require the line correctly located in front of said lots. How is it to be done? Con. 3 is 5 chains longer than con. 2. To divide equally on east boundary would cause much confusion.

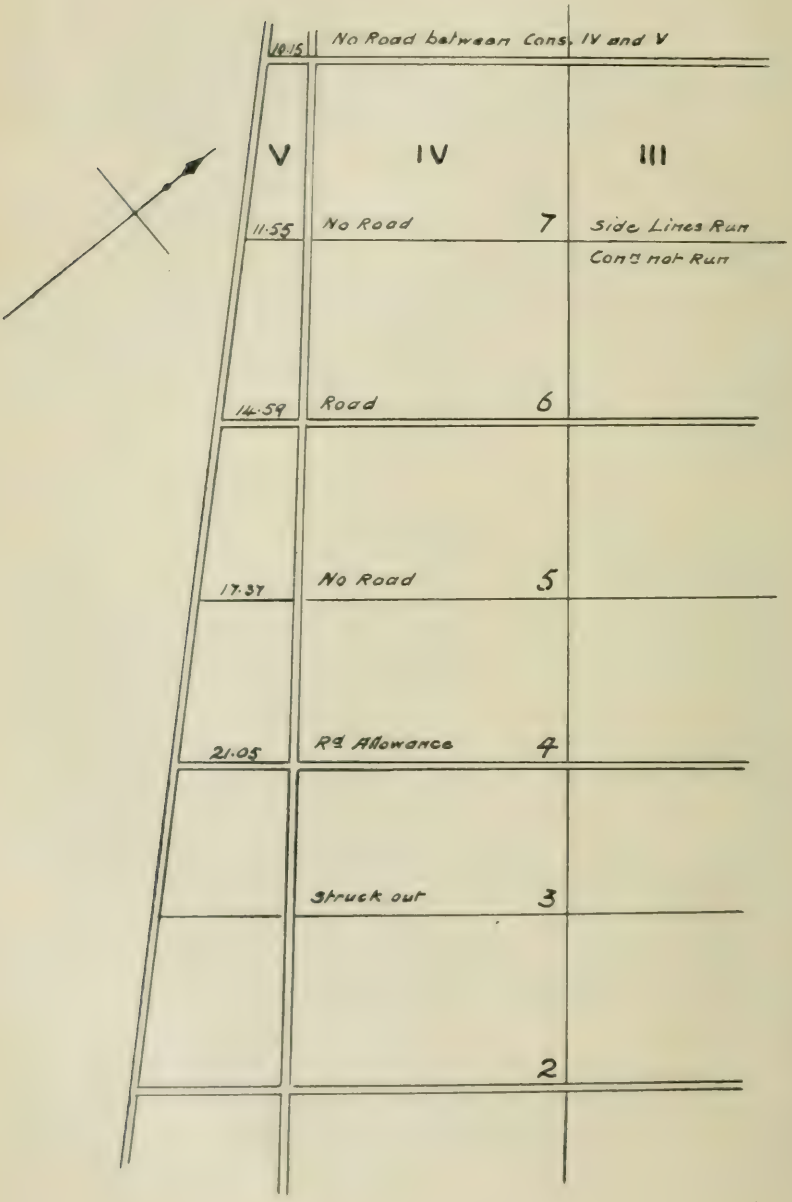
Answer.—Divide proportionately on east boundary and connect south-east angle of lot 24 thus established with post at south-west angle of lot 19 by a straight line.

Question 3 A.—How would you re-establish line between concessions ten and eleven, in this case, across lots one and two? There is an old post corner of lot 1, con. 10, south boundary. All old blazes and posts on concession line have been obliterated by fire. Centre line of concession was originally run from south boundary across lots 1 and 2, and as shown by dotted line to the west boundary. Afterwards lots 51, 52, 53, and 54 were surveyed off by another surveyor under instructions from Department, who mentions in notes that distance from south side of river along west boundary south 14 deg. 50 min. E. "to limitation of 11th con. is 40 chains 60 links, as shown on sketch." No mention made in field notes of rear of lot 53 intersecting concession line.

Answer.—Follow original survey of con. 11, establish intersection of front of same with west boundary, according to original notes, and connect with point opposite south-west angle lot 1, con. 10.

Question 3 B.—How would you run lines between lots 2 and 3 and between 3 and 4, in the township of Brudenell. How would you run line between lots 285 and 286, Range B north? Supposing none of side lines between lots 280 to 290, inclusive, have been run prior to July 1st, 1897, would you run on astronomic course

GUELPH


18.15
No Road between Cons. IV and V
V
IV
III
11.55
No Road
7
Side Lines Run
Con.s not Run
14.59
Road
6
17.37
No Road
5
21.05
Rd Allowance
4
Struck out
3
2

of line between 280 and 281, as shown in field notes, or on course of line as posted on ground ?

Answer.—Run on astronomical course. Divide proportionately along concession line between 10 and 11, and if no lines run in block prior to 1st July, 1897, run on astronomic course.

Question 4.—A private survey was made by me for "A" of parts of lots 27, 28, and 29, in the B. F. and 1st Concessions of Saltfleet, and the boundaries thereby ascertained were marked by cut stone monuments, planted with centres upon the lines. After the completion of the work, an unfriendly neighbor, "B," owning adjoining land, though not deprived of any acreage by the line surveyed, removed two of my monuments, throwing them to one side, and inscribing thereon, "The man who planted these had a h— of a cheek." I wish to know, 1st, if "B" was justified in removing the said monuments ? and, 2nd, if not, can our Association properly proceed against "B"? and, third, if our Association has the right to proceed against him, are we not morally bound to do so, in order that the acts of our profession may be respected ?

Answer.—1. Was not justified. 2. Do not think the Council would be warranted in incurring expense for protection of members' clients.

Question 5.—In running line between lots 2 and 3, con. 2, the original post on north side of road being lost, which post would you start from, that at A or B ? Which constitutes the "best evidence" of the location of the lost corner at C ? The posts at A and B have neither of them been moved since original survey, but were carelessly planted in that survey, and are not in line. To start from B would make the lot 4 links narrower than if the line was run from A. Sub-sec. 2, sec. 37, chap. 181.

Answer.—From the post at B.

Question 6.—In part of Division B, in Guelph Township (Canada Company survey), the side lines were run in the original survey, but not the concession lines. According to the field notes a road allowance was left between cons. 4 and 5, at the lines between lots 2, 3, and 3-4, but no road is shown in the notes of the lines between lots 4-5, 5-6, 6-7, nor 7-8. The plan shows a road right through, as on the annexed tracing. The patents of the south-west halves of lots 5 and 6, con. 4, give metes and bounds, and refer to a road allowance between concessions 4 and 5. The patent of the south-west half of lot 7, con. 4, gives metes and bounds, but does not mention a road allowance. Lots 6 and 7, con. 5, are described in patent by number only. A road has always been open across lots 4 and 5, but none across lots 6 and 7. The Town-

ship Council now wish to have the road allowance located with a view to selling to the adjoining owners. Is there a road allowance there, and if so, how should it be located? Should the whole of such allowance be taken off the fifth concession, as appears to have been done across lot 5? In calculating the areas for patent of 6 and 7, con. 5, there had apparently been fifty links deducted from the chainage given in the notes.

Answer.—Would recommend a municipal survey, which should be executed under the advice of the township solicitor. When confirmed by the Commissioner the dispute would be settled (sub-sec. 45 of s. 14, chap. 181).

Question 7.—In the opinion of your Committee, what is the custom of land surveyors in fixing the shore line of a lake or river?

Answer.—To take the high water mark, which is the line of vegetation.

DISCUSSION.

Mr. Niven replied to certain questions with illustrations on the blackboard. He then referred to question number 4 which had been presented to him coming from Hamilton, and said:

I sympathize very much with the surveyor in this case. I think when surveyors plant posts or monuments, in this case stone monuments, it is very wrong for any person to come and interfere with them. I have always thought that a monument planted by a surveyor should be held to be sacred, as it were, until removed by some proper authority, and although I do not see exactly how the Association could interfere in this case, I think that the surveyor is entitled to the moral support of the Association, and if anything can be done to help him in this case it should be done.

Mr. Tyrrell—Being the surveyor in this case referred to, I naturally feel strongly on the subject. B., who is referred to in the question, is making quite a boast round Hamilton of his action in the matter—of the way in which he has disregarded the survey, and considers our work of no consequence whatever. We ought in some way to try and insist on our acts being respected. I would not like the Association to go into expensive costs in litigation, but we might do something in the way of warning this individual of the consequences which he is laying himself open to.

Mr. Niven—If I understand the Criminal Code, the man who threw those monuments out left himself liable to be proceeded against.

Mr. Dickson—I think the client should proceed.

Mr. Kirkpatrick—Was it because they encroached on his land ?

Mr. Tyrrell—He does not express any theory in regard to them at all. He was not consulted in regard to making this survey. It is true the monuments were on his side of the fence. Being a worm fence one of them was directly on the centre of the old fence at one end and at the other there was nothing but an old brush fence, and it was not supposed to be the true line, which came some few feet in on his place.

Mr. Kirkpatrick—Supposing the stone monuments had not been planted there and a post had been, and he pulled that post up, that post was there to define the boundary line between his land and this widow's. Surely if he pulled up that post and threw it away, he would lay himself open under the Survey Act. No man shall disturb any man's landmark. He may say it is not mine, but it was hers, and certainly you cannot plant a post between two people's land unless you encroach. If you plant a six-inch square post, the universal practice is to plant three inches of that on one man's land and three inches on the other, so that the centre of the post shall be the dividing line. And then, on a similar argument, if you plant a monument six inches square, of course it might be possible to plant it wholly on her land and let the edge be his, but that would not be the ordinary custom with the surveyor, because a stone monument is marked generally with a cross or pointed at the top, and the extreme top is the centre. Of course he may dispute your survey, but that is not the question. I think the client ought to bring the action.

Mr. Niven—I think his act would make him amenable to the law, and it would be a simple matter to punish him.

Mr. Dickson—I had a case in the Township of Cavan, where I ran a line and the man deliberately went and pulled up all my pegs. He was summoned by my client before the Police Magistrate at Port Hope, and he threw it out altogether. The Police Magistrate said there was no law for it. He had no jurisdiction.

Mr. Bowman—The Council might obtain the opinion of a solicitor in the matter, and if the action of this Hamilton party was against the solicitor's advice, then have him warned to have the monuments put back and pay for the cost of putting them back. There seems to be a difference of opinion as to our rights in the matter, and the Association has funds and could get this thing looked into, and a report made, and an opinion given by some lawyer of good standing.

Mr. Wicksteed—It would give us strength. It does away with the value of the Association as a society if we do not assist each other in these matters.

The President—Section 42 of the Survey Act says. (Reads.)

Mr. Jones—It seems to me we have taken action in other cases perhaps somewhat differing from this. We have obtained solicitors' opinions, and I think in some cases prosecution has been made. This seems to be a straight case of law, and where the local surveyor could probably take action. I think the Council of the Association should write to this man requiring him to replace the posts and threatening a law suit if he does not do so.

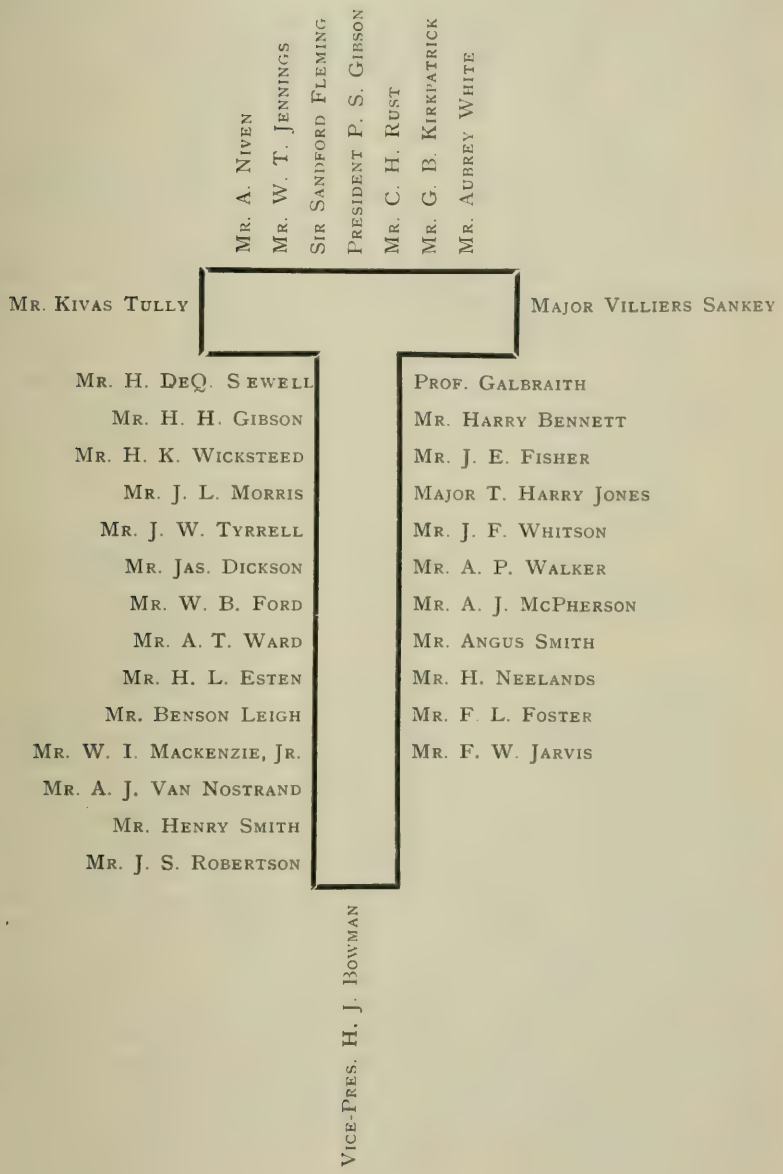
Mr. Wicksteed—I think that should be done. Anything the Association can do to support Mr. Tyrrell should be done.

REPORT OF ENTERTAINMENT COMMITTEE, 1899.

Mr. President,—Your Entertainment Committee for 1898-9 beg to report as follows:

The fourteenth annual dinner of the Association was held at McConkey's Restaurant on the evening of 1st March, 1899. A large number of members of the Association, with their guests and friends, attended, and the members were especially pleased to have with them Sir Sandford Fleming, one of, if not, the oldest and most distinguished member of the profession in Canada. The guest-list also included Mr. Aubrey White, Assistant Commissioner of Crown Lands, Ontario; Mr. W. T. Jennings, President Canadian Society of Civil Engineers; Mr. C. H. Rust, City Engineer, Toronto; Mr. Kivas Tully, Department of Public Works, Ontario, and Messrs. F. W. Jarvis and J. S. Robertson, representing respectively the legal profession and the press.

The chair was taken by yourself, as President of the Association, and the vice-chair by the Vice-President, Mr. Bowman, and after all had had sufficient of the good things provided by "mine host" for the occasion, the following programme was carried out: Toast, "The Queen," proposed in loyal terms by the President and followed by the singing of the National anthem. Toast, "Canada," proposed by the President, responded to by Sir Sandford Fleming, who related a number of interesting episodes of his earlier days. Song, "The Maple Leaf." Toast, "Ontario," proposed by the President,


Mr. A. Niven
Mr. W. T. Jennings
Sir Sandford Fleming
President P. S. Gibson
Mr. C. H. Rust
Mr. G. B. Kirkpatrick
Mr. Aubrey White
Mr. Kivas Tully
Major Villiers Sankey
Mr. H. DeQ. Sewell
Mr. H. H. Gibson
Mr. H. K. Wicksteed
Mr. J. L. Morris
Mr. J. W. Tyrrell
Mr. Jas. Dickson
Mr. W. B. Ford
Mr. A. T. Ward
Mr. H. L. Esten
Mr. Benson Leigh
Mr. W. I. Mackenzie, Jr.
Mr. A. J. Van Nostrand
Mr. Henry Smith
Mr. J. S. Robertson
Prof. Galbraith
Mr. Harry Bennett
Mr. J. E. Fisher
Major T. Harry Jones
Mr. J. F. Whitson
Mr. A. P. Walker
Mr. A. J. McPherson
Mr. Angus Smith
Mr. H. Neelands
Mr. F. L. Foster
Mr. F. W. Jarvis
Vice-Pres. H. J. Bowman

responded to in eloquent terms by Mr. Aubrey White. Songs, Mr. Bennett, "The Flying Machine" and "Just One Girl." Toast, "Sister Societies," proposed by Vice-President, responded to by Mr. Jennings, Mr. Rust and Prof. Galbraith. Toast, "Learned Professions," proposed by Vice-President, responded to by Mr. Kivas Tully and Mr. F. C. Jarvis. Song, Mr. Niven, "The British Lion." Recitation, Mr. Jones, "Sergeant What's His Name." Toast, "The President," proposed by Sir Sandford Fleming, responded to by Mr. Gibson. Songs by Messrs. Sewell, Benson Leigh, and Mr. Bennett. Toast, "The Entertainment Committee," proposed by Mr. Morris, responded to by Mr. Walker. "Auld Lang Syne" and "God Save the Queen" concluded a most enjoyable evening's entertainment.

Your Committee consider themselves fortunate in being able to secure the services of Mr. Harry Bennett, a humorous vocalist, whose selections during the evening were very much appreciated. A diagram showing the names of members and guests present is attached hereto. A statement of receipts and disbursements has been filed in the office of the Secretary-Treasurer.

All of which is respectfully submitted.

A. P. WALKER,
Chairman Entertainment Committee.

REPORT OF COMMITTEE ON ENGINEERING.

MR. PRESIDENT.—Circumstances conspired to prevent the members of the committee meeting on February 28th, as per programme, but the committee has not been idle during its term of office, as is evident from the number of papers on engineering subjects prepared for the annual meeting.

The Chairman and the majority of the committee agree that papers descriptive of proposed works that could possibly be classed as "promoters' schemes" should not appear in printed proceedings of the Association.

In looking through the proceedings for the last few years there will be found papers on mines, power schemes, railway lines, etc., that in our opinion detract from the dignity of the profession, and we would suggest that the incoming Council send a circular to each member of the Association announcing that papers of this character are not desired, although matters of this kind may be discussed at the annual meeting.

WILLIS CHIPMAN,
Chairman.

PAPERS.

[*This Association is not responsible as a body for the opinions expressed in its Papers by Authors.*]

PROGRESS OF GOLD MINING IN THE CENTRAL GOLD BELT OF THE RAINY RIVER DISTRICT.

By H. W. SELBY,
Dinorwic.

Having read the interesting paper on the above subject in the Lake of the Woods District, by H. DeQ. Sewell, O. L. S., at the last annual meeting of the Association, I have deemed it right to draw the attention of the members to what is being done in the central part of the Rainy River District, of which I believe very little is generally known.

It may be interesting to know that this belt has an area, so far as prospected and surveyed, of about 2,200 square miles, extending south-west from Dinorwic, on the C. P. R. about 50 miles and about 40 miles northeast, with a width of about 24 miles. Within this area the formation is mostly Huronian.

A glance at the very excellent map of the district described, issued by the Crown Lands Department last year, will serve to assist in the comprehension of the enormous amount of work done in the short time which has elapsed since the first prospecting was done within this belt, and although many of the plans have not been fyled, still you will appreciate the fact that the poor fly-eaten, mosquito-tormented, and hornet-stung surveyor has not been idle, and that through perils by land and perils by water, and through many tribulations, he should be congratulated on furnishing the Crown Lands Department with so much valuable information at so little cost to the country.

It is a matter of history that before July, 1895, only a dozen mining locations had been surveyed within the belt here described, and to Mr. Gillon, O. L. S., of Fort Frances, and myself fairly belong the honor of being the pioneers in this work.

It is but fair to add that throughout the whole of this district very few locations were surveyed that were not prospected for gold, and, though in a few instances only ordinary indications were the result, still on the majority of them good panning veins are found.

In the spring of 1896 the prospecting element began to be very much interested in the Manitou District, it being the south-westerly portion of this belt. In the same spring another set of prospectors entered the country north-east of Dinorwic, now known as the Minnietakie District, and gradually the two have been connected by surveys, until now we see development work quietly but persistently going on from one end of the central gold belt of the Western Ontario gold fields to the other.

In August, 1897, I had the honor to be called to pioneer a new district, now known as the New Klondike, named so from the fact that placer mining was thought possible, and considerable excitement was created by the dirt in several gulches showing rich pannings. Nothing further has been attempted in placer mining, as the quartz veins, being of so rich a nature, all efforts have been turned towards their development. The results so far have not been disappointing, and some of us may live to see that district bearing its share in the honor and glory which the central gold belt is designed to receive; but the proverbial hesitation of Canadians to venture their money in untried localities is having its influence on the development of the country, which may be aptly illustrated by the following incident:

One day meeting a Yankee Irish prospector in his canoe, he was asked how he was making it go. "Och," he says, "is it how oime making it go, your asking? Well, not very good; Canada is too slow. We have lived just forty years too soon." Joking aside, if the wealthy men of Canada could conceive of the immense wealth which nature has stored up in their own country, instead of sending their money outside for investment they would keep some of it at least to develop this mineral wealth, which, as loyal and patriotic citizens is expected of them, and not remain under the stigma which they are by not only my Irish friend, but all those who have seen this part of the Ontario gold fields in its process of development.

I have shown you thus far how, in the short space of three years, this immense tract of land has been explored and what was thought to be the best of it surveyed; and I would be pleased to go into detail and describe each property and the improvements thereon, but that would take more of your time than I have any desire to occupy. Suffice it to say there are now which I know of 10 shafts down 100 feet, 20 shafts down 75 feet, 20 shafts down 50 feet, and many others from 25 to 40 feet. One shaft only has

reached the depth of 200 feet, which is on HW 419, in the New Klondyke, and owned by the Northwestern Ontario Gold Mining Company. This vein has developed from a stringer to a width of 5 feet, retaining its values. A stamp mill is to be installed during the coming season.

One stamp mill, "The Haycock," only has been erected until this winter the Barker Bros. put in a Tremaine steam stamp mill for testing location HW 339, on the Lower Manitou. The result has been so satisfactory that they have completed the purchase of the said property for $10,000.

In the Minnietakie section, on 105 S. V., development work was carried on last winter and part of the summer. A shaft was sunk 65 feet and a crosscut of 35 feet in solid quartz by the John Sykes Mining Co., and the assays proving so satisfactory the Company are now putting in a ten-stamp mill and a saw-mill to cut the lumber and timbers for the buildings required.

In the Upper Manitou section, "The Independence," HP. 387, has been constantly worked for a year. Three shafts have been sunk, one to a depth of 100 feet, and a crosscut of 17 feet in solid quartz and a drift along the vein from No. 1 shaft to No. 2. The Company are now installing a 10-stamp mill, which shows that the results have been fully up to expectations.

There are rumors of other Companies putting in stamp mills the coming season, but the fact that so much work has been done and so few mills put in is to be taken as a good indication rather than otherwise. A stamp mill is not required, is a much larger expense to establish than people generally imagine, and if from any cause a Company ceases to operate condemns a property, until sufficient development work has been done to give a fairly correct idea of the ore in sight and its value. Here, again, comes in the lamentable cry, "Oh for some of the almost idle money of the wealthy to bring to light the unlimited mineral resources of Ontario!"

Reference has already been made to the fact that three years ago this mineral belt was practically unknown. Still, so much importance is attached to the future success of this district that the Government have spent about $10,000 in opening up roads and improving navigation; and to facilitate business and to meet the requirements of the district the C. P. R. has built three new stations at Dryden, Wabigoon and Dinorwic, with all the accompanying buildings, sidings, etc., and at Dyment sidings and a flag station, for the winter traffic to the New Klondyke.

In that time (three years) villages have grown at the above three places, stores, hotels, churches, schools, and all the necessary dwellings have grown up where three years ago the virgin forest reigned supreme. Steamboats run from all three places to assist in the work of opening up the country, which is slowly but surely

being accomplished, and with the unstinted use of pluck, elbow-grease, and capital, nothing can prevent the central gold belt of the Rainy River District from having a place among the great gold-producing areas of the world.

In conclusion, let me say, our mineral resources may be the best in the world or they may be worked more economically than any others, but we cannot expect foreign capital to become interested until Canadians show their confidence in their country by venturing to go down after the yellow stuff, and thus prove to the world what some of us are now satisfied would be the result.

DISCUSSION.

Mr. Tyrrell—I was personally very much interested in this paper. I know some of the properties, and I am glad to hear of their success.

I think, as the author of the paper is not present, we should depart from our rule and move him a vote of thanks, and I have much pleasure in doing so. Seconded by Mr. James Dickson, and carried.

Mr. Kirkpatrick—This paper has given us a great deal of information which will prove very valuable. Mr. Selby has done something that others have not done, giving us the exact location on which the development work is being performed. He mentions one, I think it is H. W. 330. I hope the owners may be successful, because they are going in pretty extensively. When I was in Rat Portage a couple of years ago prospectors were going back into Keewatin a couple of hundred miles. I understand Mr. Tyrrell went up with them.

Mr. Tyrrell—I think they did make quite a discovery up in Keewatin, but the great distance made it rather impracticable to work the property; that was the conclusion we came to.

The vein was only six inches when we started, and it looked promising, and I advised them to sink on it, and they did so, and it has been widening practically ever since. At one time they lost the vein at a depth of 100 feet, and they wrote down to me, asking what they had better do. I replied they had better not be discouraged too soon, but continue on for a few weeks at all events, and they would very probably strike it again before long. They did so, and found the vein again, and it has been widening ever since. The last report I heard was that they were getting an average across the whole width of the vein of $48 to the ton, which should give them reason to be encouraged.

Mr. Sewell—I always used to feel rather ashamed at being the only one who wrote on these subjects, and I am glad to see somebody else is going into it. I was, I think, the first to survey in the New Klondyke, and on one property we got a shaft down about 90 feet, on the Mastodon, but it has been full of water for, I think, about five or six years now. At the time there was some talk about a water power in that locality. In my mind one of the interesting features in our North-Western Ontario gold fields is water power. It is a means by which we can reduce the expenditure very much. In the New Klondyke, when I first knew it you could walk for miles without touching the ground. The engineers of the C. P. R. had been going over the ground, and in order that their lordships might have an uninterrupted view, they sent their cook boys on ahead and fired the forest, the result of which was you had to walk when you went surveying about five or six feet off the ground on these stubs. Now it is being covered with little jack pine and small scrub, but the timber is not of any practical value, which is a very material point. It is said that in British Columbia, at the Deer Park Mine, miners have been paying a dollar a pail for water to wash out their mill. They have actually had to carry it to the mill in buckets and pay a dollar a pail for it. Their pipes were all frozen and they had no water to go on with their washing. We have a good deal more water than they have, but still we need to make use of it, not altogether for washing for mill purposes, but to take the place of fuel. Electricity is being so developed that a distance of 15 or 20 miles is not anything out of the way to transmit power from our waterfalls, and I notice the Government has made very wise regulations in regard to those water powers; they can only be used and leased for actual bona fide use for mining or other purposes. Electricity will reduce the cost of mining in a great many cases fully 25 per cent., and this will often mean the difference between mining at a profit and not mining at all.

The writer of this paper says this gold belt is almost all Huronian. Now, that is as much as to say other rocks are not carrying gold. When I first went out west into that country, the Lake of the Woods was the only place where they supposed the gold was. Then they found there was gold in the New Klondyke, but still those were the early days. It was thought that the hornblende schists of the Huronian formation were the only gold bearing formations. Time went on and people came to the conclusion that if the granite happened to be up against the vein it did not injure it, and then they found if the vein got into the granite it was not any detriment. Now in some cases they get the gold only when they are in the granite. Take the celebrated Mikado Mine, they say it cuts across the granite. When they are in the granite

they get the gold, when they get out of the granite and into the Huronian schists they do not find any gold at all. Of course there are peculiar phenomena due to each particular locality. You cannot lay down any actual rule.

Dr. Dawson said, in his earlier treatise on the Lake of the Woods, there was a possibility of finding gold in the Laurentian, pure and simple, although it had not been found yet. He had seen some very nice looking veins. Now, veins are found in the old Huronian gneisses, the oldest rock which we have in Canada. They have it down at Island Falls, on Saw Bill, the Hammond Reef. The gold is not in quartz. It is in the old Laurentian rock. The rock is impregnated with gold.

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SURVEYING IN THE GOLD FIELDS OF ONTARIO.

By F. L. FOSTER, O. & D. L. S.
Mine Centre.

To members of our Association who have not made the mining districts of Ontario the scene of their professional labors, but who may contemplate doing so, a short article on the subject may prove interesting.

With a view to making it somewhat instructive as well, I have jotted down some memoranda based upon an experience of a year and a half in the Rainy River District, spent for the most part in the Lower Seine River gold fields, engaged in surveying and examining mining locations.

In the spring of 1897 I was induced by some speculative mining men, interested in the development of that part of Ontario, to open an office in the new settlement called Mine Centre, situated on the north side of Shoal Lake, a widening of the Seine River, seven or eight miles east of Rainy Lake. It is so called from its proximity to the central portions of the lately developed mining locations of the Lower Seine.

Although the feverish excitement of the previous two years had, to a great extent, died out, and most of the prospectors and mining speculators had gone to explore fresh regions, there were enough left to make business brisk at times and keep one moving about a good deal. This enabled me to examine a considerable area of country, the appearance of which seemed to fully justify the good accounts given of it by prospectors and others. By the geological maps issued by the Crown Lands Department, it will be seen that most of the mining locations at present surveyed occur in the belts of Kewatin schists, and though some of the best mines in the immediate vicinity of Shoal and Bad Vermilion Lakes occur in the Protogene and Gabbro rocks, in close proximity to the schists, it seems to be a general belief among prospectors that the Huronian rocks are the only ones worth exploring, the rest of the district having been ignored by them. From what one hears it would seem that this District has not been very widely or carefully explored.

Prospectors do not appear to have had the means necessary to thoroughly examine more than a comparatively small proportion of this large area. Even many surveyed locations are but imperfectly known, the owners being content with a superficial exploration, and the discovery of something in the nature of auriferous rock upon which to speculate, so that even in abandoned or forfeited locations good pay ore may be found by more effective exploration.

The Ontario and Rainy River Railway through this district, now in course of construction on or near the old C. P. R. line marked on the maps, will doubtless give a new impetus to prospecting in its vicinity, and will, by decreasing the present heavy cost of transporting mining machinery and supplies, greatly increase the value of good properties that might otherwise not be developed.

A surveyor of a speculative turn of mind may by assisting impecunious prospectors become part owner of locations more or less valuable.

A good property can often be secured for a small sum or a share acquired for making the survey and plan. This is frequently done with advantage to all concerned.

This brings me to a consideration of the value of a special study of practical mineralogy and geology. Of course all our surveyors know more or less about these sciences, but he who practises in the mining districts should spare no effort in applying this theory to a practical knowledge of the geological formations and minerals existing in the scene of his labors. If this is done he makes himself equal in knowledge and skill to many of the mining experts sent to examine mineral deposits and report upon partly developed properties by intending purchasers. A careful report from a surveyor accompanied by well drawn plans is often as valuable as one by the expert of wide experience. There is little or nothing that a highly paid mineralogist can do towards ascertaining the value of an incipient mine that cannot be done by our surveyors who have made the special study above referred to. An ordinary prospector, by the use of his pick and shovel, mortar and gold-pan, can readily tell whether a lead is worth developing or not, so a surveyor, equipped with a few assaying materials and testing apparatus, can make a better calculation of quantity and test of quality—one at least sufficiently accurate for a preliminary report in the initial stages of development, which can, if necessary, be in part, confirmed by a professional assayer. In this connection, I may say here, that the lectures and practical instruction given in the mining districts of Ontario, by highly efficient mineralogists,

under the authority of the Government, free of charge, to prospectors and others, are very greatly appreciated by all who receive them.

A course in the School of Practical Science is, however, very desirable, and should, I think, be taken advantage of by all who practice in these districts, adding materially to his professional prestige as well as knowledge—a matter of much importance in this sphere of action.

Books for reference and study, such as Prof. Chapman's "Minerals and Geology of Central Canada," his "Mineral Indicator," Prof. Lake's "Prospecting for Gold and Silver," etc., will be found useful if not necessary as constant companions.

A sufficient knowledge of hydraulics should be acquired by our surveyors to enable them to make an approximate calculation of the power to be developed from the numerous rapids and waterfalls on our rivers, as this will be an important factor in mining operations.

The transmission of this enormous power by means of electricity will, at no distant date, simplify and cheapen the process of mining in many places. In short, our surveying profession, in order to become a paying one in these parts, must be combined to a certain extent with that of the engineer and mineralogist. A survey of a location should, whenever early development or sale is desired, include sufficient data to allow a plan and notes to be made, showing the position of the ore vein or lode, its direction, dip and strike, a rough estimate of quantity and quality of ore; the topography, height of hills, position of lakes and rivers in its vicinity, position of waterfalls, their height and volume and rate of current, timber valuable for mining purposes, and in fact sufficient knowledge to enable an accurate preliminary report to be made. In cases where rapid surveys are required in order to secure title merely, this extra work is superfluous, and can, if desired, be done later on, but its value as a means of ready sale cannot be over-estimated, and should be done in the first survey if possible.

It may seem superfluous to mention camp and transportation outfit, as they differ but little from that used by any of our surveyors of wild lands, but to the few not accustomed to the practice under consideration, I may say that the first requisite for summer work in the region of lakes and rivers is one or two good Peterborough canoes, each capable of holding three men with camp outfit and provisions, and deep enough to carry this load over rough lake waters in heavy weather without shipping seas, and light enough to be portaged by one man.

The camp outfit may consist of two 7 x 9 tents of 8-oz. duck, with waterproof floor sheet for each; four tin camp kettles, fitted into each other so as to form one package; half-a-dozen knives, forks, spoons, and tin cups, the latter fitting in each other; small bags in which tins of pepper, salt, sugar, baking powder, etc., may be carried separately.

Provisions may consist of bacon, beans, potatoes, flour, biscuit, dried apples, sugar, tea, coffee, pepper, salt, yeast or baking powder; canned goods, consisting of tomatoes, beef, fruit of any kind, condensed milk, etc., according to taste. The total weight of these provisions should not exceed eighteen pounds for each day's consumption for a party of six men, but it is as well to have a few pounds over in case of accident or delay.

As to instruments, a small, light transit, with a three-inch limb and an expansion tripod is a good one for general use, and can be carried in its box over the roughest places without inconvenience or danger of being put out of adjustment. In the more important and widely extended surveys a larger one is, of course, necessary. A micrometer for summer work is the best instrument for traversing and getting distances across water stretches.

A small compass, with a four-inch needle and folding sights, gives good results when locations are small, the needle being only used for turning angles. It is almost useless to say that mining locations should be bounded by well cleared lines and have good-sized posts at the corners, very plainly marked with block letters and numerals. No Roman numbers ought to be put on posts, as they are apt to be puzzling to some people.

I have found in my practice that in order to secure prompt payment for surveys no trust should be allowed, either cash should be paid on delivery of plans, or an assignment in writing of an interest in the location should be demanded. It is an unfortunate fact that the majority of prospectors and mining speculators with which a surveyor has to deal are, as a rule, not men of the strictest probity, and although one meets with some of the opposite character, they are exceptions to the general rule. If I was writing a moral essay instead of jotting down a few hard facts, I would say something strong by way of warning against this lack of honor prevalent, I suppose, in most mining camps; gambling and the inordinate use of liquor being the principal causes as well as effects of this lax morality. As the life one leads in these half-civilized places constantly exposes one to the effects of these vices, I need hardly caution everyone to avoid both if he would retain his reputation, prosperity or health. During my short stay, several accidents, deaths, and murderous assaults have occurred in Mine Centre

and vicinity, caused by these vices and the lack of organized methods of preserving law and order. And then, too, so many false representations are made by holders of mining claims as to their value that one has to be constantly on his guard, and should take all accounts of "rich strikes" and "bonanzas" with some reserve, until a personal test of their truth is made. As a rule, nearly everyone is suspicious of his neighbor's veracity, and a reputation for strict honesty is only to be sustained by a fair and impartial judgment of all properties one is called upon to examine, apart from any interest he may have in them.

It is well known that this part of Ontario has suffered greatly in the estimation of capitalists and mining men in England, the United States, and Canada by the inflated accounts given by a few unscrupulous people interested in booming poor properties under false pretences with a view of making rapid sales at high prices. But the good old saying, "Magna est veritas, et prevalebit," will be found applicable here in time, and when the truth is known by actual development of its mineral wealth, this part of Ontario will in all probability take a high rank as a field for investment of capital.

DISCUSSION.

The President—Where do you bank your funds? Have you made your fortunes?

Mr. Tyrrell—We put it in barrels in the cellar.

Mr. Sewell—If you notice the map the Government has issued of that place the paper speaks of, there is intrusive granite, it has come up, it is post-Huronian, the Foley, the Lucky Coon, and the Golden Star, and the Olive are all on this intrusive belt. At the outer ridges of the Olive there appears to have been a volcano, and that has thrown it up.

Mr. Foster—All the Vermilion Lake region is supposed to be an old volcano, and in the olden times they say there was a high mountain round there, and by glacial action and other weathering it was brought down to its present level. The green Huronian schists found there are supposed to be lava. Those and the conglomerates are supposed to come from this crater. The plowing down of this action has caused the Plutonic rocks, the original granite, to be exposed and the schists to be only found on a portion of the district, so that in the highest portion, where this crater was, the Lau-

rentian rocks, gabbro and so forth are exposed, and form some valuable mines, amongst others the famous Golden Star.

Mr. Sewell—Is that Laurentian ?

Mr. Foster—Yes.

Mr. Sewell—Lawson says no. He says it is close Huronian. It is a matter of date. There are thousands of years between the two.

Mr. Foster—However that may be, these mines, the Golden Star and others, are peculiar. They are not far from the contact between the schists and this old rock, and another peculiarity of that and other mines in the vicinity is that they increase in value as they go down. In nearly all the leads that have been developed in that part of the country the rock has increased in richness, and the veins in width as they get deeper. This is a very important fact, and it does not occur in all parts of Ontario nor British Columbia.

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EXPLORATIONS.

By JAMES DICKSON, O.L.S.

Fenelon Falls.

Mr. President,—In presenting a paper on the above subject, it is not my intention to go to any great extent into details, but simply, from my point of view, draw the attention of this Association to a few of the reasons why more exploratory surveys should be made.

In the early history of the country an occasional line was projected into the unknown wilderness and made the base of future surveys. But it is only within the last few years, when the base lines in the Rainy River District were run and the more recent production of the western boundary of the Nipissing District to James' Bay, that explorations were reduced to anything like a system.

We are indebted chiefly to geological surveyors for our knowledge of the geography of our Province even in the vicinity of the settled portions. Those parties were generally in charge of a chief not skilled to any great extent in the art of surveying, the party consisting of, at the most, only three or four persons, the primary object being to get a knowledge of the mineral resources of the country, with a passing glance at its fauna and flora. Each party is assigned a certain district for a season's operations. They have not the requisite skill, nor are they furnished with the necessary instruments to either take observations, or make anything approximating an accurate survey. In fact, they are to do a maximum amount of work at a minimum of erpense. And I have no doubt when to their skilled eye a section of country shows no indications of mineral wealth, many objects of importance both from a scientific and a commercial point of view have been entirely overlooked.

The accuracy with which many of the lakes and streams have been laid down on plans by these gentlemen speaks volumes for the care they have taken in the discharge of their duties.

Other parties have at various times been intrusted with exploratory surveys in certain districts of rivers and lakes But the smallness of these parties and the difficulty of transit made it

imperative to take the lightest and least accurate description of instruments. And the chief has been often compelled for self-preservation also to cover a maximum of territory in a minimum of time. Portions of his work have been done while seated in his canoe in a drenching rain, a driving snow-storm, or tossed at the mercy of wind and waves. His skill taxed to the utmost to preserve the lives of himself and party, leaving little time to devote to the primary object of the expedition.

Large sums of money have been expended in the prosecution of these surveys, and collections of valuable information stored up for for use of future generations, but a trifling addition to the outlay, small in proportion to the value of the results obtained, would not only have made these surveys much more accurate, but would have saved large expenditure in future. But in addition to what has been accomplished up to date a very large percentage of our vast Province is still a sealed book except to the hunter and trapper.

I need scarcely point out to an audience such as this is, skilled in the use of the compass, how frequently the magnetic needle is deflected from its true course even when there are not the slightest indications of any mineral presented to the eye, nor how those variations box around, in short distances, from one degree up to a large are of the circle, without the operator having the least idea that there is anything wrong, unless at each and every station he takes a careful back sight to some well defined object, a thing manifestly impossible with the staff and means at his disposal.

Should his traverse start at one accurately defined point and terminate at another equally well established, when he comes to plot his survey he may find himself miles out, with no means of finding out either where the error began or ended. But should neither the starting nor ending point have been accurately laid down, he may be out from beginning to ending, and either himself, if prosecuting the work further, or the one following in his footsteps, will not only perpetuate, but most likely increase, the error.

True observations for both latitude and longitude may be taken from time to time, but we all know how frequently consecutive days and nights may pass without either sun, moon, or stars being visible, and long distances passed over between observations, so even this does not meet the end in view.

A surveyor is instructed to proceed to a given point and project a line for a distance of fifty or one hundred miles or more. He has a numerous party, consequently a large store of provisions is necessary and his expenses for transportation a heavy item. He has no previous knowledge of the country, nor can he find

any reliable man who has. Along with his instructions he receives a map of the country on which are shown the principal lakes, rivers, and canoe routes, with as much accuracy as mortal man with the means at his disposal is capable of. Glancing over this map, which he assumes to be approximately correct, the surveyor soon fixes the route by which his supplies can be forwarded to points which will be either intersected by his line or adjacent thereto. He gives his packers the necessary instructions, together with a sketch of the route they are to pass over, also a hint as to the time at which he expects them to be at a certain point, takes an observation, and commences work. Some fine evening, when all virtue has gone out of both bacon and flour sack, and sundry other useful articles have also become exhausted, he makes the rendezvous, and instead of finding the much needed supplies they may be "miles, miles away," and starvation staring the whole party in the face before a junction of the two parties is effected, and the work may have to be suspended for days.

It has never fallen to my lot either to have charge of such a survey or to be even engaged on one, so that I can only theorize. But as some of the gentlemen present have, I should be much pleased to learn from them whether their experiences have proved my theory correct or otherwise.

I would suggest that the whole of the unsurveyed part of the Province of Ontario be divided into sections, and lines run due east and west and due north, at intervals of eighteen miles. Each section would thus embrace nine townships of thirty-six square miles each. Have the lines well opened out, well blazed, and mile-posts, either of iron or durable timber, and properly marked, erected, so that any person travelling through the woods and striking a line could locate himself accurately in a few minutes. During the progress of the survey, whenever a lake or river of any extent or volume was struck by the line, a compass and micrometer traverse of its shores could be made, if it was only for a few miles on either side. A couple, or, at most, three men, would suffice for this, and, from the points thus established, fairly accurate sketches of the intervening country could be made by any person at all skilled in woodcraft.

Were a system such as this, or one along similar lines, carried out, in the course of a few decades we would have an invaluable topographical map of the whole Province, and the value of the information thus obtained would be far in excess of the cost incurred.

I have no doubt but that the amount of money saved to miners and lumbermen during the last few years in the Rainy River Dis-

trict by having the recently surveyed exploration lines to locate their operations from has been more than the original cost of the lines.

It has been urged by some that the cash expended on many of the surveys undertaken by the Government in recent years has been thrown away, and, in so far as the Province has benefited, might as well have been sunk in the depths of the sea, and that the public should not be called upon to furnish funds for the benefit of a few lumbermen and miners. But they entirely overlook the large outlays those gentlemen have to make before they realize any returns, and the quantity of produce and manufactured articles they consume which are drawn from the centres of industry. I submit that if there are any undeveloped industries in any section of the Province, or hidden treasures in either our rocks, lakes, or rivers, it is the bounden duty of every Government to assist liberally in their development. There are few articles of either agriculture or manufacture that are not required to some extent in each and every community. Each section of country has generally some particular line of industry peculiar to itself, and it is only by a fair interchange of their various productions that nations and individuals obtain their wealth.

DISCUSSION.

Mr. Tyrrell—I think we are all agreed that it would be a very desirable thing if those exploratory surveys could be carried on in advance of the township surveys. The difficulty seems to be to get such a system under way. Has anything been done to bring the matter before the Government urging the desirability of such a move? If not, I think it would be very desirable that a Committee should be appointed and this matter pressed upon the Department of Crown Lands.

Mr. Dickson—There was something done, I think, towards having a topographical survey made of the whole Province.

Mr. Whitson—Each year the Government spends the small appropriation at their disposal advantageously, and last year two very important meridian lines were run, one from a short distance east of the Sault to its intersection with the main line of the Canadian Pacific, about 100 miles in length, and the other an extension of the boundary between Nipissing and Algoma to the Moose River.

I think Mr. Dickson's paper pretty well voices the sentiments

of all mining men and those who have had anything to do at all with the exploration, and the running of base lines within the last few years, and especially in the Rainy River District, was a great convenience to mining men. It is absolutely necessary that all mining locations should be tied on to some known point, and before the base lines were run in this District it was very expensive to lay out a mining location, but now it is easily done. No point is very far from a base line now. Timber limits are also now easily located.

Mr. Dickson—I would like to hear from any gentleman whether they have had much difficulty in forwarding their supplies to the different points on their lines.

Mr. Sewell—I always found by following a system you have very little trouble. Have one man responsible for the whole thing. I always manage to get along pretty well, I get some one who can talk Indian, or occasionally hire an Indian.

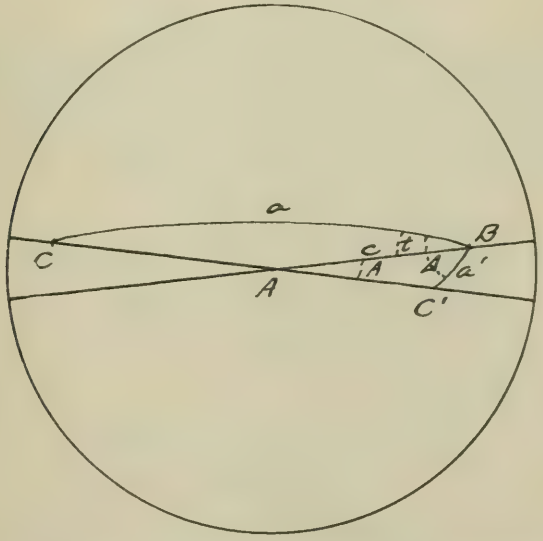
[*This Association is not responsible as a body for any opinions expressed in its Papers by Members.*]

TIME AND AZIMUTH BY STARS, OBSERVED ON THE VERTICAL OF POLARIS.

By L. B. STEWART,
Toronto.

This paper contains the derivation of formulae for reducing transit observations for time and azimuth of stars across the vertical of Polaris.

The observation may be made as follows: The transit having been set up, the sight line is directed along the line whose azimuth is to be determined and the horizontal circle read. It is then directed to Polaris, and the time noted, and the horizontal circle



again read. Then, keeping the instrument clamped in azimuth, the time of transit of some other known star across the same vertical is noted. If desired, this operation may be repeated on some other star with the instrument in the reverse position, the times of

setting on Polaris and of transit of the other star being noted, and a second reading of the horizontal circle being taken. A second reading on the reference mark should also be taken. By this means the effect of errors of adjustment of the instrument will be nearly eliminated.

The latitude of the place of observation is also required in the reduction.

The above diagram is a projection of the celestial sphere on the plane of the horizon. AB is the meridian, A the zenith, B the pole, C′ the position of Polaris at the time of its transit, C that of the time star. Then if

ϕ = the latitude of the place.
δ = the declination of the time star.
δ' = the declination of the pole star.
p = the polar distance of the pole star.
t = the hour angle of the time star.
A = the azimuth of the pole star, reckoned from the north.
Δ = the angle CBC′.

we have from the diagram

$$c = 90^\circ - \phi$$
$$a = 90^\circ - \delta$$
$$a' = 90^\circ - \delta' = p.$$

As the transits of the two stars are not observed simultaneously, the angle Δ differs from the difference of right ascension of the two stars by the interval of time between the two transits, that interval being reduced to sidereal time if a mean time watch has been used in taking the observations, so that

$$\Delta = (a' - a) - (\tau' - \tau) \qquad (1)$$

T′ and T being the observed times.

Then from Sph. Trig. we take the equations:

$$\sin \Delta \cot C = \sin a \cot a' - \cos a \cos \Delta \qquad (2)$$
$$\sin B \cot C = \sin a \cot c - \cos a \cos B$$
$$\sin A = \frac{\sin a \sin C}{\sin c}$$

which may be written:

$$\sin \Delta \cot C = \cos \delta \tan \delta' - \sin \delta \cos \Delta$$
$$\sin t \cot C = \cos \delta \tan \phi - \sin \delta \cos t \qquad (3$$
$$\sin A = \frac{\cos \delta \sin C}{\cos \phi}$$

These equations contain the solution, but they must be transformed in order to adapt them for logarithmic computation, and to solve for t.

The first of (3) may be written:

$$\cot C = \frac{\cos \delta - \sin \delta \cot \delta' \cos \Delta}{\sin \Delta \cot \delta'}$$

then, introducing the auxiliary θ, such that

$$\tan \theta = \cot \delta' \cos \Delta \tag{4}$$

it becomes:

$$\cot C = \frac{\cos \delta - \sin \delta \tan \theta}{\sin \Delta \cot \delta'}$$

$$= \frac{\cos (\delta + \theta)}{\cos \theta \sin \Delta \cot \delta'}$$

Substituting the value of cot δ' from (4)

$$\cot C = \frac{\cos (\delta + \theta)}{\tan \Delta \sin \theta}$$

or

$$\tan C = \frac{\tan \Delta \sin \theta}{\cos (\delta + \theta)} \tag{5}$$

Substituting the above value of cot C in the second of (3), we have:

$$\sin t \frac{\cos (\delta + \theta)}{\tan \delta \sin \theta} + \sin \delta \cos t = \cos \phi \tan \phi$$

Dividing through by sin δ and introducing a second auxiliary θ' such that

$$\tan \theta' = \frac{\cos (\delta + \theta)}{\tan \delta \sin \theta \sin \delta} \tag{6}$$

it becomes:

$$\sin t \tan \theta' + \cos t = \frac{\tan \phi}{\tan \delta}$$

or

$$\cos (\theta' - t) = \frac{\tan \phi \cos \theta'}{\tan \delta} \tag{7}$$

The equations (4), (6), and (7) determine t and (4), (5), and the third of (3) determine A.

The above is a rigorous solution of the problem, but as t and A are small angles they may be expanded in series, and by that means much more convenient expressions for practical use may be obtained.

To expand t in series write the first of equations (3) in the form:

$$\tan C = \frac{\sin \Delta}{\cos \delta \cot p - \sin \delta \cos \Delta}$$

$$= \frac{\sin \Delta}{\cos \delta \cot p (1 - \tan \delta \cos \Delta \tan p)}$$

$$= \frac{\sin \Delta}{\cos \delta} \tan p (1 - \tan \delta \cos \Delta \tan p)^{-1}$$

then expanding by the binomial theorem and substituting for tan p the expansion

$$\tan p = p + \frac{p^3}{3} +$$

neglecting powers higher than the third, this becomes on multiplying out and arranging

$$\tan C = \frac{\sin \Delta}{\cos \delta}\,(p + \tan \delta \cos \Delta\, p^2 - \tan^2 \delta \cos^2 \Delta\, p^3 + \tfrac{1}{3} p \qquad (8)$$

Again, transposing the second of (3) and dividing by $\sin \delta$, we find

$$\sin t \frac{\cot C}{\sin \delta} + \cos t = \frac{\tan \varphi}{\tan \delta}$$

Then, t being small, we have by expanding its sine and cosine and neglecting terms of a higher order than the third,

$$\left(t - \frac{t^3}{6}\right)\frac{\cot C}{\sin \delta} + \left(1 - \frac{t^2}{2}\right) = \frac{\tan \varphi}{\tan \delta}$$

Then multiplying out and arranging

$$t \frac{\cot C}{\sin \delta} - \frac{t^2}{2} - \frac{t^3}{6}\frac{\cot C}{\sin \delta} = \frac{\tan \varphi}{\tan \delta} - 1$$

$$= \frac{\sin (\varphi - \delta)}{\cos \varphi \sin \delta}$$

$$= \frac{m}{\sin \delta} \text{ (assume)}$$

t must now be found by a series of approximations. Thus, assume as a first approximation:

$$t \frac{\cot C}{\sin \delta} = \frac{m}{\sin \delta} \text{ or } t = m \tan C$$

then substituting this value of t in the second term of the above series, we find as a second approximation

$$t \frac{\cot C}{\sin \delta} - \frac{m^2}{2} \tan^2 C = \frac{m}{\sin \delta}$$

or

$$t = m \tan C + \frac{m^2}{2} \sin \delta \tan^3 C$$

Finally, substituting this value of t in the second and third terms, we find on reducing

$$t = m \tan C + \frac{m^2}{2} \sin \delta \tan^2 C + \frac{m^3}{6} \tan^3 C$$

Then substituting in this expression the value of tan C given by (8), multiplying out and neglecting as before terms of a higher order than the third, we have

$$t = m \frac{\sin \Delta}{\cos \delta} p + m \frac{\sin \Delta}{\cos \delta} \tan \delta \cos \Delta\, p^2 + m \frac{\sin \Delta}{\cos \delta}\left(\tan^2 \delta \cos^2 \Delta + \tfrac{1}{3} + \frac{m}{2} \sin \delta \frac{\sin^2 \Delta}{\cos^2 \delta} - \frac{m^2}{6} \frac{\sin^2 \Delta}{\cos^2 \delta}\right) p^3$$

In this series t and p are in circular measure, substituting
$t \sin 1''$ and $p \sin 1''$
for t and p, and dividing through by $\sin 1''$, we have (t and p being now expressed in seconds of arc):

$$t = m \frac{\sin \Delta}{\cos \delta} p + m \frac{\sin \Delta}{\cos \delta} \tan \delta \cos \Delta \, p^2 \sin 1''$$
$$+ m \frac{\sin \Delta}{\cos \delta} \left(\tan^2 \delta \cos^2 \Delta + \tfrac{1}{3} + \frac{m}{2} \sin \delta \frac{\sin^2 \Delta}{\cos^2 \delta} \right.$$
$$\left. + \frac{m^2}{6} \frac{\sin^2 \Delta}{\cos^2 \delta} \right) p^3 \sin^2 1'' \qquad (9)$$

in which

$$m = \frac{\sin (\varphi - \delta)}{\cos \varphi}$$

If the time star be observed below the pole, then m becomes

$$\frac{\sin (\varphi + \delta)}{\cos \varphi}$$

and the term

$$\frac{m}{2} \sin \delta \frac{\sin^2 \Delta}{\cos^2 \delta}$$

changes its sign, and t is the hour angle, reckoned from the meridian below the pole.

The third term of eq. (9) may always be neglected except where extreme precision is required. In the example worked out in the Manual of Dominion Lands Surveys, on p. 83 it amounts to about one-eighth of a second of time. The first two terms contain the equations used in the construction of the tables given in the Manual.

If the third term is to be computed, then the series may be written in the form:

$$t = m_1 n p + m n_1 p^2 \sin 1''$$
$$+ m n_1 (n_1^2 + \tfrac{1}{3} + \tfrac{1}{2} m n_1^2 \sin \delta + \tfrac{1}{6} m_1^2 m^2) p^3 \sin^2 1'' \qquad (10)$$

in which

$$m_1 = \frac{\sin \Delta}{\cos \delta} \qquad n_1 = \tan \delta \cos \Delta$$

The azimuth may also be expanded in series as follows:—Writing eq. (8) in the form

$$C = \tan^{-1} \left\{ \frac{\sin \Delta}{\cos \delta} (p + \&c.) \right\}$$

and expanding by means of the series

$$\tan^{-1} x = x - \frac{x^3}{3} +$$

we have

$$C = \frac{\sin \Delta}{\cos \delta} (p + \tan \delta \cos \Delta \, p^2 + \tan^2 \delta \cos^2 \Delta \, p^3$$
$$+ \tfrac{1}{3} p^3 - \tfrac{1}{3} \frac{\sin^2 \Delta}{\cos^2 \delta} p^3)$$

and also by the third of (3)

$$A = \sin^{-1}\left\{\frac{\cos\delta}{\cos\varphi}\left(C - \frac{C^3}{6}\right)\right\}$$
$$= \frac{\cos\delta}{\cos\varphi}\left(C - \frac{C^3}{6}\right) + \frac{1}{6}\frac{\cos^3\delta}{\cos^3\varphi}\left(C - \frac{C^3}{6}\right)^3$$
$$= \frac{\cos\delta}{\cos\varphi}C - \frac{1}{6}\left(\frac{\cos\delta}{\cos\varphi} - \frac{\cos^3\delta}{\cos^3\varphi}\right)C^3$$

Then substituting the value of C given above, multiplying out, and reducing as before, we obtain

$$A = \frac{\sin\Delta}{\cos\varphi}p + \frac{\sin\Delta}{\cos\varphi}\tan\delta\cos\Delta\, p^2\sin 1'' + \frac{\sin\Delta}{\cos\varphi}\left(\tfrac{1}{3} + \tan^2\delta\cos^2\Delta - \tfrac{1}{2}\frac{\sin^2\Delta}{\cos^2\delta} + \tfrac{1}{6}\frac{\sin^2\Delta}{\cos^2\varphi}\, p^3\sin^2 1''\right) \quad (11)$$

The third term here may also generally be omitted, but if it is retained the series (11) may be written in the form:

$$A = m_2\, p + m_2\, n_1\, p^2\sin 1'' + m_2\left(\tfrac{1}{3} + n_1{}^2 - \tfrac{1}{2}\, m_1{}^2 + \tfrac{1}{6}\, m_2{}^2\right) p^3\sin^2 1'' \quad (12)$$

in which

$$m_2 = \frac{\sin\Delta}{\cos\varphi}$$

and as before

$$m_1 = \frac{\sin\Delta}{\cos\delta}$$
$$n_1 = \tan\delta\cos\Delta$$

Comparing equations (9) and (11), it is seen that if the third terms be neglected

$$t = A\frac{\sin(\phi - \delta)}{\cos\delta} \quad (13)$$

$$A = t\frac{\cos\delta}{\sin(\phi - \delta)} \quad (14)$$

If preferred, after finding the hour angle of the time star, that of Polaris may be computed by deducting t from Δ, and the azimuth of the latter star may be computed from the data: latitude, hour angle, and declination. Applying an equation similar in form to the first or second of (2) to the triangle ABC', we have

$$\sin t' \cot A = \cos\phi\cot p - \sin\phi\cos t'$$

which equation may be placed under various forms for practical use. Thus, writing it in the form

$$\tan A = \frac{\sin t'}{\cos\phi\cot p - \sin\phi\cos t'}$$

and dividing both numerator and denominator by $\cos \varphi \cot p$, it becomes

$$\tan A = \frac{\sin t' \sec \phi \tan p}{1 - \cos t' \tan \phi \tan p} \tag{15}$$

which is one of the equations given in the Manual for the reduction of azimuth observations. It requires subtraction logarithms.

Again, writing it in the form

$$\tan A = \frac{\sin t'}{\cos \phi \tan \delta' (1 - \tan \phi \cot \delta' \cos t)}$$

and introducing the auxiliary θ, such that

$$\cot \theta, = \cot \delta' \cos t'$$

or

$$\tan \theta, = \frac{\tan \delta'}{\cos t'} \tag{16}$$

it becomes

$$\tan A = \frac{\sin t'}{\cos \phi \tan \delta' (1 - \tan \phi \cot \theta,)}$$

$$= \frac{\sin t' \sin \theta,}{\tan \delta' \sin (\theta, - \varphi)}$$

or, eliminating $\tan \delta'$ by (16)

$$\tan A = \frac{\tan t' \cos \theta,}{\sin (\theta, - \phi)} \tag{17}$$

Equations (16) and (17) give the solution.

Or, again, A may be expanded in series, thus:

$$\tan A = \frac{\sin t'}{\cos \phi \cot p (1 - \tan \phi \tan p \cos t)}$$

$$= \frac{\sin t'}{\cos \phi} \tan p (1 - \tan \varphi \tan p \cos t')^{-1}$$

Then, expanding by the binomial theorem, we have

$$\tan A = \frac{\sin t'}{\cos \phi} \tan p (1 + \tan \phi \cos t' \tan p + \tan^2 \phi \cos^2 t' \tan^2 p +)$$

and then, expanding tan. p as before and reducing, the expression becomes

$$\tan A = \frac{\sin t'}{\cos \phi} (p + \cos t' \tan \phi \, p^2 + \cos^2 t' \tan^2 \phi \, p^3 + \tfrac{1}{3} p^3)$$

which may be written

$$A = \tan^{-1} \left\{ \frac{\sin t'}{\cos \phi} (p + \&c.) \right\}$$

Expanding again as before and reducing, we have

$$A = \frac{\sin t'}{\cos \varphi} . p + \frac{\sin t'}{\cos \varphi} \cos t' \tan \varphi \, p^2 \sin 1''$$

$$+ \frac{\sin t'}{\cos \varphi} \left(\tfrac{1}{3} + \cos^2 t' \tan^2 \varphi - \tfrac{1}{3} \frac{\sin^2 t'}{\cos^2 \varphi} \right) p^3 \sin^2 1'' \tag{18}$$

The third term in this series will seldom amount to more than

a few seconds, and may generally be neglected. Its value evidently increases with the latitude, as also appears from the following table, which contains some of its values, p being taken for the year 1900:

φ	$t =$ 1 h.	$t =$ 2 h.	$t =$ 3 h.	$t =$ 4 h.	$t =$ 5 h.
20°	0.24	0.36	0.31	0.15	−0.02
30	0.36	0.54	0.45	0.17	−0.13
40	0.64	0.93	0.74	0.19	−0.37
50	1.28	1.85	1.40	0.22	−0.97
60	3.13	4.47	3.27	0.29	−2.72
70	10.79	15.33	11.01	0.42	−10.20

An examination of this table shows that this term attains a maximum positive value for an hour angle slightly exceeding 2h. and changes its algebraic sign at a little over 4h. By equating to zero the first derivative of the term with regard to t as the independent variable, and then placing the portion of the term within the brackets equal to zero, reducing in each case and solving for t, we obtain the two expressions

$$\sin^2 t' = \tfrac{1}{3} \cdot \frac{1 + 2\sin^2\varphi}{1 + 3\sin^2\varphi}$$

$$\sin^2 t' = \frac{1 + 2\sin^2\varphi}{1 + 3\sin^2\varphi}$$

the first giving the value of t, for which the third term of (18) is a maximum, and the second its value for which that term vanishes. In latitude 45 deg. N. it will be found by the above equations that these two values of t are, respectively,

	2 *h.*	4 *m.*	21.8 *s.*
and	4	13	44 5

and these values change slowly with the latitude. The conclusion, then, is that in Ontario the third term of the series (18) may be omitted whenever an error not exceeding 5" may be neglected, and especially when the hour angle is in the neighborhood of 4h.

The above method of obtaining the azimuth of a line should be a very useful one for the practising surveyor. By providing himself with a list of the apparent places of about a dozen stars, taken from the Nautical Almanac, and so chosen that one is always available for observation shortly after sunset at any time during the summer, the surveyor will then be in a position to observe for azimuth at the time h. considers most convenient, instead of waiting for the elongation of Polaris. The reduction of the observations by means of equations (11) and (13), the latter giving the watch correction, is not a very laborious matter.

The following observations were taken on March 29th, 1899, to find the azimuth of a line and the watch correction:

Pt. observed	*H.C.R.*	*Watch.*
Ref. Mark	45° 18′	
Polaris	73° 33′ 30″	8 *h.* 30*m.* 51*s.*
ζ Hydræ	"	8 24 43

The apparent places of the stars were:

	R.A.	*Decl.*
Polaris	1 *h.* 21 *m.* 21 *s.*	+ 88° 46′ 23″
ζ Hydræ	8 50 6	+ 6° 19′ 35″

The data then were:

$\Delta = 111° 13'$ (Eq. 1.)
$\varphi = 43° 39' 36''$
$\delta = 6° 19' 35''$
$p = 4417''$

To find the azimuth: eq. (11)

log sin Δ	= 9.96952	
" p	= 3.64513	
" cos φ	= 9.85941	
	13.61465	
" 1*st* term	= 3.75524	1*st* term = 5692″
" tan δ	= 9.04480	
" cos Δ	= *n*9.55858	
" p	= 3.64513	
" sin 1″	= 6.68557	
" 2*nd* term	= *n*.68932	2*nd* term = − 5″

$\therefore A = 5687'' = 1° 34' 47''$

To find the hour angle of the time star: eq. (13)

log A	= 3.75488
" sin $(\varphi - \delta)$	= 9.78280
" cos δ	= 9.99735
	13.53768
" t	= 3.54033

$\therefore t = 3470''$
$= 231s. = 3m. 51s.$

To find the azimuth of the reference mark:

Az. of Polaris	= 358° 25′ 13″
H.C.R. on Polaris	= 73° 33′ 30″
Az. of 0° of Circle	= 284° 51′ 43″
H.C.R. on Ref. Mark	= 45′ 18′
Az. of Ref. Mark	= 330° 9′ 43″

Azimuths are here reckoned from north in the direction in which the degrees of the circle are numbered.

To find the watch correction:

R.A. of time star	= 8*h.*	50*m.*	6*s.*
West hour angle	=	− 3	51
Sidereal time	= 8	46	15
Long.	= 5	17	35
Greenwich sid. time	= 14	3	50
Sid. time at Gr. mean noon (N.A.)	= 0	26	14
Elapsed Sid. interval	= 13	37	9
Corresponding solar interval (=Gr. mean time)	= 13	34	55
Standard time	= 8	34	55
Watch face	= 8	34	43
Watch correction on St. time	=		+ 12*s.*

The third terms in equations (10) and (12) in this example are found to be 0″ - 05 and 0″ - 44 respectively, so that they are safely neglected.

DISCUSSION.

Mr. Van Nostrand—It is some little time since I studied these formulae, and I do not just at first blush take them all in, but I think that a great many of us by reading the paper in the Report, and making a study of it, will be able to learn a convenient method of taking an observation. And I suppose those of us who have sat up all night waiting to get Polaris in elongation will thoroughly appreciate any method that will let us out of it.

Mr. Dickson—I do not think any of us are thoroughly capable of discussing this paper at first sight. A great many calculations have been made, and it is very carefully prepared, but it is only when it is printed in the Report and we sit down at home and study it out we will appreciate all its advantages.

Capt. Gamble—I do not think our Surveyors as a rule, when requiring the meridian, take observations of Polaris except at its greatest elongation; but with the information given us in this paper, one may choose a much more convenient time for obtaining the azimuth.

Prof. Stewart—I was tied to the method of elongation when in practice. If you have a reliable timekeeper it is most useful in obtaining azimuth from observation of Polaris at any time. But if you have not a good chronometer, by observing two stars on the same vertical circle the time is not necessary. The latitude, however, must be known, but it can easily be found closely enough for all practical purposes.

[*This Association is not responsible as a body for any opinions expressed in its Papers by Members.*]

MORE REMINISCENCES OF AN OLD LAND SURVEYOR.

By C. UNWIN,

Toronto.

Having been requested by the Chairman of the Biographical Committee, of which I am a member, to write in addition to those given in 1897 a few more of my reminiscences for the coming meeting, I will do my best to comply, although I fear they may possess little interest for my brother surveyors—perhaps it may prove not entirely uninteresting to follow me on a survey to Lake Superior and stay awhile at the Islands of Michipicoten and of St. Ignace.

In looking over my Diary for the year 1864 I find under 8th September that I, in company with Mr. H. R. Fletcher (a gentleman who had employed me to lay out some mining locations in the above district), left Toronto at 7 a.m. by the Northern Railway train, arriving at Collingwood at noon, and left by the steamer Algoma about 3 p.m., reaching Killarney at 7.30 on the morning of the 9th, Little Current at 11 in the morning, and Bruce Mines about 11 p.m. Probably most of you know that Killarney was formerly called She-baw-we-naw-ning, which puts me in mind of an unwilling stay made there in the summer of 1852 on my way to Manitowaning to fetch some pork which had been left there for me to be used on the survey of the Indian Reserve at Garden River. We were detained by head winds for some time, and when we got to Manitowaning found that the pork had been left on the wharf in the broiling sun and had become so bad that it could not be used. I heard a story of a Frenchman, one I suppose of a surveying party, who was starved to death at this same She-baw-we-naw-ning many years ago. He had been detained there waiting for provisions. This was during the winter, and the last four entries in his diary were (I do not remember the date, but will say): "—— day of ——,—Packmen not come yet; very hungry; eat one snowshoe." Next entry: "—— day of ——,—Still no packmen; eat other snowshoe." The next entry: "—— day of ——,—Packmen not come yet; eat one moccasin." And concludes his last entry with: "Packmen not come yet; eat other

moccasin; She-baw-we-naw-ning damn poor place." It is not so bad now, for it is a very important fishing station—in fact there are few, if any, better on Lake Huron.

10th. Arrived at Garden River about 9.12 in the morning, and remained about two hours taking in wood. While the wood was being taken in Mr. Fletcher, Mrs. McIntyre (wife of Mr. McIntyre, of Fort William), daughter and niece, and I went ashore and called upon Rev. Mr. Chance, the Church of England missionary residing at Garden River. John Lindsay, P. L. Surveyor, came aboard the steamer at Sault Ste. Marie. He was going to lay out some mining locations near Black Bay. Mr. Lindsay told me that Mr. Devine, the Chief Clerk in the C. L. Department, said that the locations might be laid out at right angles to the shore of the lakes or rivers, if not convenient to run them due north and south.

11th. Arrived at the mouth of Michipicoten River about 7 a.m., where left a mail bag and one passenger, Mr. Rankin, father of the gentleman in charge of the Hudson Bay Company's post at Michipicoten. Mr. Fletcher and several of the passengers went up to the post, and Mr. Fletcher brought a small canoe back with him. Arrived at Michipicoten Island about 2 p.m. Mr. Fletcher's boat, with five men, met us about a mile from the shore. Mr. F., I understood, had charge of a mine on the Island, and these men had been working under him. Walked around and examined the place. A fire had recently raged all through, burning up some of the houses.

12th. With five men left the mines to survey a ten-acre lot at Quebec Harbor, and searched for a line that had been run by P. L. Surveyor A. P. Salter some years back for Bonner's eastern boundary.

13th. Found Bonner's eastern boundary with pickets still standing; traced this line down to the shore and found a post about one chain north therefrom, etc., etc. Quebec Harbor is for its size one of the best harbors, if not the best harbor, on Lake Superior. Mr. Fletcher hired the schooner "Delia Wright," of Gosfield, to take us to Island of St. Ignace. She was 38 tons burden, and commanded by an old salt, aged about 70 years, rejoicing in the name of Lamphire; with him the mate, a fine, handsome Norwegian, named Solomon Tosteson; Jim, a half-breed Indian; and Julian, a Frenchman. We left Quebec Harbor about 9 p.m.; had a fair wind, but it was a very rainy night.

14th. Was very sick all last night, as was also Mr. Fletcher. I could not sleep down in the small cabin (it was only about 7 feet

square), so remained on deck all night and all next day. We got within a few miles of our destination about 8 a.m., but the wind got contrary and strong, and we were obliged to make for a harbor; tried Arran Bay, but being too foggy, missed it; tried the Pic, about 45 miles from Otter Head, and missed it, so tried Otter Head Harbor, and fortunately made it about 4.30 p.m., and anchored for the night. Had a most uncomfortable bed in the hold of the vesesl, on a box about 3 feet 6 inches long, and it was very hard. I do not see it mentioned in my diary, but I have a very vivid recollection of part of a night trying to sleep in the hold of the adorable "Delia Wright," on a bag of Liverpool salt, and a more uncomfortable or harder bed I never had, and I have tried a good many, viz.: balsam, cedar, and hemlock brush; granite, rock, and sand, the latter being an approach to Liverpool salt, but not as hard by a good deal; and, to make matters worse, there were a lot of domestic fowls loose in the hold which were not at all particular as to where they made their deposits.

15th. There being a head wind, we were unable to proceed, so remained at Otter Head all day, and, having nothing better to do, literally gorged ourselves with the finest blueberries that I ever saw, and our cook, thinking to cap the climax, gave us blueberry pudding for supper at night.

16th. Weighed anchor about 5.30 a.m., and having little or no wind, beat about Otter Head until about 6 p.m., when it freshened, and, being fair, we had a good run; a beautifully clear night; not having got over my repugnance to my limited quarters in the hold, I slept on deck.

17th. Arrived at Moffat's Harbor at noon and anchored; got under weigh again about 3 p.m., and reached Harrison's Landing at dark; rainy night; went ashore for a few minutes, but it was too dark to do or see anything to advantage.

Sunday, 18th. Walking on the shore looking for minerals, etc., having previously hauled the schooner to an old wharf. In the afternoon took out boat and moved a mile or two westward, where encamped. Took observation of Polaris about 7 p.m.

19th. With Mr. Fletcher and men coasting down the main lake. After dinner Mr. F. and some of the men went further up the bay, and I tried the variation of the needle at different places; found an immense deal of local attraction; in one place the needle pointed very nearly due east and west.

20th. With most of party making search for the south-west angle of the Hamilton location; found a stump flattened on three sides, with some lettering in red chalk, but could not make out what it was. Also found a spruce tree squared, with Sept. 5th,

1846, marked on it; presuming the chalking to have been done at the same time, it had stood the weather eighteen years.

24th. Completed the survey of location on the 24th; were most hurried; the captain of the schooner, being very short of provisions, urged me to come away, saying he would be obliged to leave me if I did not come to-day. Weighed anchor about 6 p.m.

Sunday, 25th. Had a good run all last night; wind continuing fair, until about 3 a.m.; then became nearly a dead calm until 11 this morning, when freshened and got quite blustering. We reached within about a mile or two of Michipicoten mines by 7 or 8 in the evening, but could not make them.

26th. Blew fresh from midnight; we were beating and trying to get a landing at the mines, but did not succeed; were quite close several times; abandoned the attempt about 8 a.m. The wind was so strong that it was not safe to try further, so made for Otter Head Harbor with stay foresail, having been obliged to take down the other sails; arrived at the harbor about 11 a.m.

27th. Left Otter Head this morning; wind being too strong to enable us to land at the mines, were obliged to go forward to Quebec Harbor, on Michipicoten Island, where remained all night. Mr. Fletcher and I encamped on the Island; rest of party remained in the schooner.

28th. Still unable to land at the mines. About noon some of Mr. Fletcher's men took his boat and went from Quebec Harbor to the mines.

29th. Schooner left Quebec Harbor early this morning and met the first load of passengers about two or three miles from the mines (these passengers were the wives and children of the miners who had been employed under Mr. Fletcher). Returned with large boat and canoe and brought off the remainder of the passengers. All on board a little before noon. Saw two American fishing boats, and spoke one of them. There were thirty people crowded into the little vessel—twenty-four from the mines on Michipicoten Island, four of a crew, Mr. Fletcher and myself.

30th. Wind continued fair but light until about 5 a.m., when we got opposite Montreal River; then beating off Maimanse all day, and between Maimanse and White Fish Point lighthouse until about 8 o'clock next morning.

Saturday, 1st October. Went ashore for a short time near White Fish Point lighthouse; continued at anchor until evening, when tried for about an hour to proceed on our journey, but being unable returned and anchored.

Sunday, 2nd. Weighed anchor about 3.15 p.m. The mate having called for assistance to raise the anchor, I left my sleeping place on the deck (where I had been made tolerably comfortable by the mate putting one of the sails about me) to assist, and while doing so some of the others hoisted my sail and with it my satchel containing my field-book, comb and brush, and razor, etc.—beards were not then fashionable even among surveyors. Seeing a propeller towards evening coming down the lake, making for the "Soo," I thought it a good opportunity of cutting the acquaintance of "Delia Wright" and her motley crew, for a time at least, so got one of the men with me to intercept the propeller with the canoe we had with us, and with some little difficulty managed to get on board. Our canoe was not seen until the propeller was nearly upon us; it proved to be "The F. W. Backas," of Chicago. We remained at Waiska Bay all night.

3rd. Left Waiska Bay early in the morning and overtook "Delia" about a mile from the entrance to the canal. Arrived at the "Soo" between 7 and 8 a.m. When I met Mr. Fletcher's men at the American side of the river, they were all looking very blue, his cheques to them having been refused by the store-keepers there. Came to the Canadian side about noon. When landing, one of Mr. Fletcher's men, who had been tasting some of Uncle Sam's whiskey I presume, slipped and fell into the river; he had his pipe in his mouth when he fell in, and retained it until he was fished out. The miners that Mr. Fletcher had working for him at Michipicoten Island were a pretty rough set, some of them Cornishmen; one of them threatened to murder Mr. F., not having received his wages; it was all I could do to pacify him. I told him that he was like them, engaged by a company, and was suffering as well as the rest. I don't know how they settled it at last, for I left them at the Canadian side of the river and came home by way of Detroit. I found that American bills were at a great discount at this time. I bought a few things on the American side: $1.50 American money equalled only 80c. Canada; $2 American money equalled only $1.20 Canada; 25c. American money equalled only 15c. Canada, etc.

4th. I left Sault Ste. Marie at 9 a.m. by steamer "Iron City" for Detroit; found the purser, a Mr. Stevenson, to be the brother of Mr. Stevenson, a merchant of Sutton Georgina, whom I knew. I also made the acquaintance of a Mr. Robson of London C.W. who had been working at Marquette; he was on his way home for his family to return with them to Marquette.

5th. Arrived in Detroit 5 p.m., and while there saw a very melancholy sight; there were heaps and heaps of cases piled on

the platform at the depot, containing the bodies of soldiers slain in the Civil War. I left by train for Toronto a little after 6 p.m., and fortunately met an old friend in charge of the Pullman car, who gave me the first good bed I had had for many days.

6th. Arrived in Toronto early in the morning of the 6th; had just time to refresh myself with a good wash and breakfast and to get to the meeting of the Board of Examiners, and receive the fees of Mr. James Warren and George Albert Simpson, who were this day admitted into the noble, but unremunerative, profession of Provincial Land Surveyors. I was then Secretary of the Board. Mr. Passmore, my predecessor, had kindly attended to my duties during my absence.

I fear the foregoing will have proved very dry; I wish I could have made it more interesting.

DISCUSSION.

Mr. Kirkpatrick—In 1863 I made my first survey on the Garden River, and I remember very well the depreciation in American money at that time. One dollar of Canadian money was equal to three dollars American money, and I had an Indian who hailed from an island just opposite Garden River, who had got very much mixed in his ideas about Canadian and American money. Being an American citizen, he could not understand how Canadian money could be any better than American, and he insisted on being paid in American money. The consequence was, as I could not persuade him to take Canadian money, I got him for a very small amount. When we were coming home by boat we found they had not raised the prices on the American side at all. You could stay for four dollars a day at any of the first-class hotels in the United States, so my two chain-bearers and I went down to Cleveland and to Niagara Falls, and put up at the International or the Cataract, and had a good time, and when we came back to Toronto I found it cost me less than it would have cost coming down on the old Algoma to Collingwood. I had not the same faith in the American money as my friend the Indian, George Opekosh or O-be-gosh!

Mr. Niven—Those names mentioned by Mr. Unwin are familiar to me. My first connection with She-baw-we-naw-ning was in the fall of 1863. I went up to survey a township on the Manitoulin Island. It was the first Government survey I ever had. Three surveyors went up at that time, four intended to go, but John Grant, of Belle-

ville, was left behind. The three were Mr. McPhillips, the father of the McPhillips' at Winnipeg; Mr. Joseph Hobson, who was then engineer of the Grand Trunk, and myself. Grant was not in time to catch the train, but the three of us went up in the steamer Rescue, which sailed from Collingwood. I remember passing Shebaw-we-naw-ning, or Killarney, and then we landed at Little Current; the starting point for myself and Mr. McPhillips was at Sheeprock Bay. Mr. Hobson had a township further up the lake, and he went up into West Bay in the Township of Bidwell. We worked there all winter, going out on the 20th November, and I got through my township about February or March. I had taken the precaution to write to the Government to tell them I would be through at a certain time, and asked them if I might go on with another township, and they replied that I might, until the opening of navigation. Mr. Hobson said nothing until he got through, and then went home by the ice, while I went on with the township of Billings, and I had the half of it done when Mr. McPhillips got through with his. Mr. Grant, who was left behind, came by Owen Sound. He hired a boat and had great difficulty in getting up, arriving about Christmas, having nearly been lost in the ice. We came down together in May. We camped out all winter. We had no stove in those days. We had our tents pitched, and then we built a cabin on top of the snow, and putting the fire in the centre thawed it out. We used to sit in the evenings there, and we had our meals in there, and when we wanted to go to bed we went out of doors into the camp. It was pretty cold sleeping. It was not as comfortable as nowadays, but not a single one of the party had the slightest cold or sickness of any kind. At that time I lived at St. Mary's, and a friend of mine there, a Dr. Wilson, said to me, "Mr. Niven, you had better have a box of medicine put up to take with you." I told him to go down to the drug store and put up what he thought was necessary, and he put up a box about a foot square. What was in it I do not know. I paid $4 for it, and we took it out and carried it all around and brought it home again unopened. I took it to the drug store again and asked him to take it back again, and he said he did not want it. I said, "Give me something for it," and he gave me a dollar!

Mr. Kirkpatrick—I may tell you what Mr. Niven in his modesty is silent about—that the surveys that were sent in by him and by Mr. Hobson at the time he speaks of are models to the present day. I show young men those plans and field notes, and they cannot improve on them very much.

Mr. Esten—I wish some of the older members in the Association would take in what we said in the Report of the Biographical Committee seriously, and turn their attention to writing papers as

to their reminiscences. Mr. Unwin has written twice, and I do not think we can induce him to write again. A great many of the members of the profession seem to think it a very good thing to have some sort of history kept, and I think this object might be fulfilled by members writing papers of this nature. As Chairman of the Committee, I would be very much obliged if some of the older members would take this into consideration next year.

Mr. Foster—Previous to Mr. Niven being up on the Manitoulin Island, I was on an exploration survey of the island, at least we intended to explore it. Mr. Hawkins engaged me to superintend the party, and we went up. Nobody seemed to know what the island was like, excepting a few hunters and the Indians there. My friend, Mr. John D. Evans, will recollect the circumstances vividly; he was with me, and so was Mr. Hawkins. The latter thought we could survey the island from end to end without a tent, taking only a little pork and flour. We got tents, but he objected to them! We waited a week or two and had a Council with the Indians, but they sent us back, and said they would not allow us to examine the island at all.

[*This Association is not responsible as a body for any opinions expressed in its Papers by Members.*]

HIGHWAY CULVERTS AND BRIDGES.

By A. W. CAMPBELL,

Toronto.

The majority of Canadians, when visiting Europe, are impressed with the durability and solidity which characterizes the structures of that country. Private residences are built to withstand the wear of centuries. Cathedrals, public halls, libraries, and similar civic institutions are constructed, not merely for the present, but for future generations. Among the works marked by this durability are to be classed the public highways, with all that pertains to them. Canada, in this regard, presents a very unfortunate contrast.

It can justly be argued that Canada is a very young country, and that England is a very old country; that Canada is not a wealthy country, and that England is a very wealthy country. While England is, in a way, a very old country, yet it is not so much older than this country in the arts of civilization, which should teach our citizens and municipal councils the necessity for and the means of wisely spending money in permanent improvements. And while England is a richer country than Canada, that greater degree of wealth has been brought about, to some extent, by the very durability which we have so long avoided. Permanent improvements are the cheapest. Structures which need props and repairs within a year or two after they have been built, seem to be in a chronic ctate of starvation, with a ravenous appetite for money. Canadians have not yet entirely outgrown the idea that they live in a pioneer land where the needs of the present entirely overwhelm the future. In nothing is this temporary building more apparent than in our highways, and in no detail of our highways is it more striking than in the matter of bridges and culverts. At the same time there is no portion of the making of a road that offers more scope to the road maker than in providing substantial and permanent waterways. Instead of the handsome stone and concrete arches that span so many of the streams intersecting the highways of England, there are to-day in this country scores of wooden boxes and trusses—flimsy, disjointed, unsafe; the constant

source of accident, and the bottomless pit into which councils are annually throwing money in a vain endeavor to keep them in repair.

LOCATION.

Considerable attention is generally paid to the selection of a good site for a bridge, and an effort is made to decide in the interest of economy, usually with a considerable measure of success. There is, however, a tendency to cling to the line of original survey, rather than deviate the road slightly, when by doing so, much would be gained in lessening the dimensions of the bridge, securing firm foundations for piers and abutments, reducing the cuts and fills of the approaches of the bridge; all of which, while they may not decrease materially the first cost, very frequently are of the utmost consequence with regard to maintenance, and may decide for good or bad the usefulness of the entire roadway. The utility of a road with respect to hauling heavy loads, is not governed so much by the condition of the best section as by the worst; not so much by the level portion as by the steepest grade. Bridges, forming, as they do, a means of crossing valleys, are intimately associated with the problem of judiciously choosing between directness of route, easy gradients, and details of construction. The location of culverts is a matter of very common error. Water should be disposed of in small quantities, along natural water-courses, before it gathers force and headway. Instead of this principle being followed, water is frequently carried long distances by the roadside, past water-course after water-course, rather than build a culvert or culverts to carry it away without injury to the road. Where culverts are needed, they should pass directly across the road and carry the water away from it.

The size of bridge or size of culvert involves nice discrimination, in which local circumstances and the class of construction introduce various factors. For the size of waterway, no hard and fast rule can be given. Many existing culverts and bridges were at one time of sufficient size, but the clearing and draining and cultivating of the land now permits the water after a rainfall to reach the water-course in a shorter time with increased volume, causing submerged roadway and flooded roadsides, while culverts and bridges are swept away. The best guide to a proper size of waterway is an intimate acquaintance with the locality or the evidence of others who are, with respect to maximum rainfall, height of water line, previous experience as to floods, form and inclination of the stream and area to be drained, kind and condition of the soil, and similar details. Talbot's Formula, proposed more as a guide to the judgment than as an unalterable rule is at times very useful:

Area of waterway in square feet C. $\sqrt{}$ (drainage area in acres)^3 acres) 3. C is a variable co-efficient, and the values given are: "For steep and rocky ground, C varies from 2-3 to 1, etc. For rolling agricultural country, subject to floods at times of melting snow, and with the length of valley three or four times its width, C is about 1-3; and if the stream is longer in proportion to the area, decrease C. In districts not affected by accumulated snow and where the length of the valley is several times the width, 1-5 or 1-6, or even less, may be used. C should be increased for steep side slopes, especially if the upper part of the valley has a much greater fall than the channel at the culvert."

Waterways should be neither needlessly large, nor of too small dimensions, involving on the one hand unnecessary expense for first construction, and on the other hand, injury to the road, wash-outs, expensive repairs, and delay to traffic.

MATERIALS.

The materials available for culvert construction in addition to timber, are sewer-pipe, concrete pipe, iron pipe, brick, stone, and concrete. Culverts are sometimes made of one of these materials alone, or of two or more in combination. When the dimensions of a bridge are reached, concrete and stone abutments and piers, with iron or steel superstructure; or stone, brick, or concrete, alone or in combination, are the materials gaining favor.

SEWER-PIPE.

For the small culverts, sewer pipe is very economical and durable, if well laid. To render them secure against the test of a Canadian climate, they should be laid with a good grade, and the ends protected with concrete, stone, or brick headwalls, with deep aprons. The joints should be made water-tight with cement. These precautions will provide against the action of frost and will prevent the culvert being undermined by water passing along the outside of the pipe, either from the ends or through the joints. Care should be taken to excavate a concave bed for the pipe to rest in, always laying the spigot ends up grade. The pipe at the outlet should be set flush with the surface of the ground. If set higher than the surface the fall of water will wash out a depression and will in time undermine the end of the culvert. A too rapid grade will cause the same result. It is frequently well to cobble-pave the outlet, where this undermining action is likely to occur.

CEMENT-CONCRETE PIPE.

Excellent culvert pipe of concrete can be manufactured cheaply in any gravel pit under the immediate direction of the municipal

engineer. The pipes are three or four inches in thickness, according to diameter, which latter may safely and conveniently reach three feet. The implements required are of the simplest kind. The most important are two steel spring cylinders, one to set inside the other, leaving a space between the two equal to the thickness of the finished concrete pipe. By "spring-cylinder," it may be explained, is meant such a cylinder as would be formed by rolling an iron plate into a tube without sealing the joint. With the smaller of these cylinders the edges overlap or coil slightly; but are so manufactured that the edges may be forced back and set into a perfect cylinder. These two cylinders, with joints flush, are set on end, the one centrally inside the other, and on a firm board bottom. The concrete, made of first-class cement and well-screened gravel, is then tamped firmly but lightly into the space or mould between the two cylinders. The tamping-iron used to press the concrete into place is so shaped as to fit closely to the cylinders. The concrete is allowed to stand in the mould for a few hours, when the cylinders are removed; the outer and larger cylinder by inserting an iron wedge into the joint, and forcing the edges apart; the inner cylinder, by inserting the wedge into the joint and turning the edges so as to allow them to again overlap, returning to the shape of a coil. The outer cylinder having thus been made larger and the inner one smaller, they can readily be taken away, and the concrete pipe is then left until thoroughly hardened. Just such a number of pipe as are actually required for rthe season's work need be manufactured; the implements required are inexpensive, and the pipe may be made by the municipality for actual cost, which, after a little experience, can be reduced to a very small amount. Culverts of concrete pipe are laid in a manner similar to those of sewer pipe.

ARCH CULVERTS OF STONE AND CONCRETE.

There is no departure which would more enrich the highways than the general use of stone and concrete for the construction of bridges and culverts. They cost more in the first instance, but the longer life, the fewer repairs needed, the greater convenience, the lesser liability to accident, render them in every way desirable. Concrete and stone are the only materials with which really permanent work of this nature can be constructed. Bridges and culverts of rubble masonry have existed in Scotland and Ireland with scarcely any repairs for more than a century, since before the time of Telford and Macadam. Concrete bridges and roadbeds built by the Romans nearly 2,000 years ago are still in use, in spite of efforts to destroy them in military operations. The cost of this class of work is constantly decreasing through the cheapening and improv-

ing of cement, through the lessened expense of procuring stone and crushing it, and through growing experience in the use of cement. In Scotland it is common for farmers to contract for rubble concrete bridges, provide the stone, and hire masons to do the work. In this way the entire expenditure is kept in the locality, among the people who pay the taxes, and is, therefore, in spite of a slightly greater cost, not unpopular. Up to forty foot spans, this construction is not difficult.

In the construction of a stone arch the first consideration is the foundation. The depth to which the excavation must be made will depend chiefly upon the span of the arch, and the nature of the natural soil on which it will rest. The chief object is that it shall be secure. If bed rock comes to the surface it may be safe to rest the base of the arch upon it without any further excavation. A firm hard-pan may exist a short distance below the surface of the ground. But a quick-sand, or other insecure footing, may necessitate the sinking of piles, or the placing of a wide, and perhaps deep, concrete base. But the foundation must be sufficient to provide that the washing of water cannot undermine it, that the lateral thrust of the embankments cannot move it, nor that the weight of loads cannot cause it to sink. No more definite rule can safely be given than to make the most of local circumstances, with always a fair margin for safety. Full-centre arches—that is, entire semi-circles—are easily formed, possess great strength, and have little lateral thrust, but with wide spans, they necessarily rise to a correspondingly great height, and cannot always be employed. A segmental or flat arch will lessen the rise, but has a considerable lateral thrust, which necessitates very strong abutments. A compound arch, made up of a number of different circles, when rightly proportioned, combines the advantages of the two, reducing the height, and at the same time having an excellent appearance. The thickness of the arch and abutments depends on a number of details, the chief of which are: the form and size of the arch, the quality of the material composing it, and the character of the workmanship. The haunches of shoulders should be built from the spring of the arch half way to the top.

With regard to the masonry, first-class hydraulic cement should be used. The arch stones should be full-bedded in cement, and each course afterwards thoroughly grouted. Each stone should be cleaned and dampened before being placed in the arch. Improperly dressed stones should be re-cut, as no hammering should be allowed after the stones are set. The ring-stones should be dressed into a wedge shape, so that they will radiate truly from the centre of the circle, and should be so dressed that the joints need not exceed three-eights of an inch in width. The ring-stone should be of such thickness as to expose ten inches on the inside

or face of the arch. The exterior of the arch should be flushed with a one inch coat of cement and the surface then smoothed off.

Arch-culverts and bridges of cement-concrete can be more cheaply constructed than can masonry arches, and, if careful workmanship is employed, are quite as serviceable. They are formed by constructing a curbing and thoroughly ramming the concrete into it in successive layers. The manner of mixing the concrete depends on the character of the cement used, some cements being slow setting, others quick setting; some will set well in water, while others will not; some will allow a considerable proportion of water to be used in forming the mortar, while other cements should be but slightly moistened. One feature in connection with concrete culvert work is that, with the curbing and centres in place, any intelligent workman can, by following the instructions of the engineer, lay the concrete. Manufacturers complain that masons, in the great majority of cases, entirely disregard the instructions given them with respect to the mixing of cement, and follow their own methods of mixing common mortar; while a man totally unaccustomed to work of this description will obey instructions carefully and minutely. Concrete cannot be mixed and put in place like common mortar, and by overlooking this fact much concrete work has failed, and has brought the material into disrepute in some localities.

BRIDGE ABUTMENTS.

The most substantial substructures of bridges are of either stone or concrete. In their construction sufficient excavation must at first be made to properly contain the abutment, and this earth may be refilled again so as to form approaches to the bridge. The excavation completed, when concrete is used in whole or in part, the portion thus constructed must be boxed and curbed in a substantial manner the exact size and shape required. After the concrete has set this boxing is removed and earth filled in solidly around the face of the abutments. Hammer dressed stone should crown the concrete to form a bridge seat.

Concrete should be composed of first-class cement; a clean, sharp, silicious sand entirely free from earthy particles and coarse enough to pass through a twenty-mesh and be retained on a thirty-mesh sieve; clean screened gravel, the largest not to be more than two and one half inches in diameter; or in place of gravel, broken stone that will pass through a two-inch ring. These materials should be mixed in the proportion of one of cement, two of sand, and three of gravel or broken stone, with just sufficient water to form a plastic mass. The sand and cement should first be thoroughly mixed when dry, then water added to make a thick paste,

and this thoroughly mixed again. This mortar is then spread out and the stone or gravel added, when the whole is mixed together until every stone is thoroughly coated with mortar. When this is done the concrete may be put in place and should be spread out and pounded until the excessive moisture appears on the surface.

DESIGN OF IRON BRIDGES.

The design of iron or steel bridges commonly erected may be classified under: The plain beam or girder; the beam truss; the suspension truss; and the bowstring or arch truss. The first of these is well understood; the second comprises those trusses in which both bottom and top chords are essential; the third includes those inwhich the upper chord only is necessary; the fourth is not properly a truss, but an arch, in which the horizontal tie takes the place of fixed abutments. The style chosen should be governed by circumstances and economy; but apart from this any design is good so long as it can be accurately analyzed as to the character and amount of strain in all its parts. On the other hand any design which cannot be so analyzed should not for a moment receive consideration. The course pursued by some, indeed most municipalities, in erecting iron bridges is likely, however, to result disastrously, and throw iron and steel into disrepute. A council advertises for tenders. The companies responding supply their own plans and specifications. Thus far the procedure is entirely satisfactory. The difficulty arises when the councils accept the lowest tender without obtaining the advice of an experienced builder of iron bridges as to the plans and specifications submitted. Cases have occurred in which a difference of five dollars has influenced a council to accept a tender for a bridge which manifestly, to a man of experience, was worth less than the other by several hundred dollars; and which was indeed unsafe, offering every likelihood of failure with attendant loss of life and great expense for reconstruction. It is difficult to understand the action of councillors, shrewd in other matters, in the construction of bridges and other public works proceeding with such apparent disregard for the true interests of those whom they represent. A small sum spent in securing reliable advice is as much a matter of economy in public as in private affairs.

Mr. Morris—Referring to the work of Municipal Councils and their inspectorship of municipal bridges, if you look at the map of the Province you will see that the county in which I am engaged

as engineer (Renfrew) has probably larger streams than any other county in the Province—the Madawaska, Petewawa, Bonnechere. These streams are all crossed by large bridges, and I have had the superintendence of most of those bridges, and find great difficulty with regard to Municipal Councils. Each Council or each Councillor has some friend who wants to make a plan for them. Their engineer is not notified, they have the plan prepared, and then they ask their engineer to see the work carried out. The contract is let before the plan is submitted to him, and he has either to repudiate it altogether, or follow it as best he can.

There is a bridge about 300 feet long over the Madawaska, where the engineer was instructed to make a report as to an iron bridge with stone abutments, and piers, costing about $9,500; or a wooden bridge with stone abutments, costing altogether about $6,000. The Municipality induced the Government to give them a little help and showed the report to the engineer. They afterwards got their local contractor to bring to me a sketch of the kind of bridge they wanted, a cheap one. I reported that the bridge was not satisfactory—that is, as a permanent bridge. It was strong enough, but the timbers and other parts were not satisfactory, and I took it on myself to suggest changes. They appointed their own inspector and built the bridge. The Government inspector, in inspecting it, found out it was not according to the plan on which the Government would grant their vote, and now the municipality is looking to the engineer to explain it. The engineer should have refused in the first place to make a plan of a bridge of that kind. The bridge is strong enough, but not the class of bridge for crossing over such a stream. The municipalities often say they have the bridge that is satisfactory, and they want one the same as it. But we can hardly blame Councils altogether for the bridges. A case is on record of three different bridges—one at Indian Branch of the Madawaska, one over the Muskrat River at Pembroke, and one in the Township of Pembroke. They are built on a plan made by the Public Works Department of this Province, for the outlying districts. The bridge has timbers from 14 to 16 inches in size for the main braces, and without any counter braces. In the one over the Muskrat, the flooring is of light stringers, put on resting on a cross beam. The three bridges were built by a contractor who has built this class of bridge throughout the country, and his idea was they would suit those different places. The flooring has given way in all three cases, and accidents involving large costs are occurring.

I built a bridge over the Indian River nearly adjacent to the one built over the Muskrat on a different plan—that is, as Mr. Campbell has just stated where the main braces and all the heavy materials are spliced and where they are bolted. The bridge I

condemned over the Muskrat in the town only lasted ten years and cost something like $5,000. The timbers are condemned because they contained a great deal of sapwood.

I have come to the conclusion that throughout the older parts of this Province we must find some other material besides pine timber. We have either to use iron altogether, or fall back on cedar. Over the smaller streams I put three cedars, deep bolted, and cross-braced across, making one solid piece about two and a half to three feet in depth, with spans 20 to 24 feet. Such a bridge will last 40 or 50 years, built altogether of cedar. The covering is six to eight inches thick, and that is the only part that will require renewal from time to time. The span will practically have to rot away before the bridge will become dangerous.

If we all had strength of mind enough to refuse to make any plan, or accept any recommendations from the Councils as to the style of bridge and allow them to appoint another engineer from time to time, then we would be in a better position.

Mr. Campbell—I can appreciate the references made by Mr. Morris, to the effect that local engineers are, as a general thing, cramped by the limited cost in the construction of all these works. For that reason he is to some extent dictated to by the Council as to the class of bridge which must be built. It is one of the weaknesses in the municipal system which I think we have to educate the people out of. In the vicinity of Pembroke, and possibly in a good many of the municipalities in the northern part of Ontario, cedar timber such as Mr. Morris specifies can be readily secured at a reasonable cost, and it makes a first-class structure. In the older townships, however, and in the more distant parts of the Province of Ontario, where this material has disappeared altogether, and where they have to go outside for the purchase of all kinds of material, lumber and timber which they used to find right in the neighborhood of the bridge, having to be brought now from the northern part of the Province. I say that it is not economy at present prices to use material of a perishable character, but that it is the duty of the engineer to strive as far as possible to extend the limit of cost allowed him, or the appropriation allowed him for doing work of a permanent character upon one structure at least. Object lessons in every municipality are necessary and desirable. I know in one county where about eight years ago they commenced the construction of iron and steel bridges with concrete and stone foundations. These were looked upon as being very expensive at the time, but after a few were constructed the people saw they were durable, and they saw the wisdom of making use of this kind of material.

The next question was that of flooring. Flooring, they said,

was perishable. This plank costs in the neighborhood of $16 to $17 per thousand delivered at the work and about $25 per thousand upon the bridge, and one bridge which I have in my mind now, in the County of Elgin, used to cost about $400 to floor it. About every five or six years this had to be renewed. The next thing is for the Councils to say what they can substitute for this one particular part of the perishable structure. This year they are specifying for vitrified brick laid upon patent steel lattice work. This vitrified brick will be used as paving brick, and laid in cement, and for the ordinary travel over the bridge it should last for at least 50 years, possibly for a century.

The President—We are told that these iron and steel bridges have to be painted every third or fifth year. If that is neglected, how long will it take a quarter inch plate to rust through ?

Mr. Campbell—I refer to the question of painting in my paper. It is said that if an iron bridge is painted the first summer after it is erected, and then after three years, if proper material is used the evaporation is small and it should stand seven or eight years without re-painting, but I think they should be kept properly painted.

The President—Suppose they are neglected and not painted, how long will quarter inch plates last ?

Mr. Campbell—It would take a good many years to eat them through, but it would not take long to weaken them so as to affect the limit of safety required in the original specifications. I think ten or fifteen years would weaken them sufficiently to render them dangerous.

Mr. Morris—Do you not find if you leave paint off wooden bridges they will crack and that allows the moisture to get in ? Even when the timber is green it does not seem to crack so much if you paint it.

Mr. Campbell—If you leave the under side of the stick free, I suppose it would be well to paint the other three sides, leaving the under side unpainted. Perfect seasoning would then take place.

The President—I have had a good deal of trouble with iron bridges. I find that it is almost impossible to get corporations to paint them. I have a bridge now under my charge about 300 or 400 feet long and 100 feet high. I have put in the estimates year after year requiring an appropriation to paint the bridge, but I cannot get it. We are told by all bridge companies if you do not paint these bridges they will become dangerous, and we are told wooden bridges if protected from rot will last forever. You cannot use iron without gases or acids reaching and rusting it. An-

other peculiar thing is this, when iron bridges are built the paint you put on is in the majority of cases metallic oxide, linseed oil, and turpentine. You plaster that over the bridge, and you have got a good coat of rust to start with. I wrote to a number of bridge companies about this before recommending iron bridges, and I got various replies. One was that there was no such thing as good paint on the market—no paint that will stand. You have to renew it, brush it off with steel brushes, and re-paint it. If you cannot brush it off why it needs less paint.

On Yonge Street, at York Mills, one iron bridge put up cost about $15,000. I could have put up a wooden bridge there for $1,500.

Our practice in bridge building in the County of York is to cut all timber up to five or six inches in thickness and never to paint it, but we cover it with galvanized sheet iron very carefully, and we put in an iron chord, just a single bar with turn buckles, because you find carpenters in country places who as a rule get these works do not cut it down so fine but you have to get it drawn up by turn buckles. Some bridges have been up twenty years now. We take a little care in putting in the joint where the main braces go into the stringer into the chord braces, lining that with galvanized iron. Mr. Bowman and I examined one of these bridges that had been carried away by a big freshet. The wood was as white as the day it was put up, the joint was as white as that table, having the galvanized iron in the joint.

We must have iron bridges, I suppose, because lumber is getting dearer and poorer every year, but we must get our Councils to understand that painting has to be done. We cannot build wooden bridges much longer. I would not recommend a wooden bridge over 50 or 60 feet, in any case.

In reference to our drains, the difference between Canada and England is that we have much severer frost in this country; nothing can withstand it, and this requires a great deal of drainage. Our laws for draining lands and roads are very defective.

Mr. Bowman—In my part of the country people have pretty well decided to give up using wood for bridges, and they have a great many iron bridges in the County of Waterloo. Some of the older railway bridges are examples of how long an iron bridge will last. Take the bridges on the Grand Trunk which have now been in place for nearly 45 years, and they have been strengthened from time to time on account of the heavier loads, but the same old material is still there and the stone foundations used in the majority of cases are still in good condition where properly looked after.

The use of brick on the Grand Trunk was not very satisfactory for culverts. We found along the old Grand Trunk when they first built it they adopted the methods used in England and put in a great many brick culverts. They are all right in the interior

through the large embankments. The Councillors in the County of Waterloo are putting down some expensive stone piers and abutments under their personal direction, as Mr. Morris mentioned. They do not require an engineer for anything of that kind. They will spend $5,000 or $10,000 in putting down stone abutments where possibly, if they had an engineer in charge of the work, it would be done for half the money with concrete, and it would be a better job, too. I would like to ask Mr. Campbell what difference he finds between the cost of concrete and the best stone, for abutments. It seems to me one is less than half of the other.

Mr. Campbell—Take Western Ontario; stone is not to be found there in the vicinity of the work, but gravel is easily found in abundance, in which case the cost of concrete foundations is not more than about one-half of that of masonry. For concrete $5 is a low estimate, $6 is a maximum, while masonry will cost you $14 per cubic yard.

Mr. A. J. McPherson—I have had a little experience in Municipal Council work. I remember a case last year. The Township Council of North Dumfries built a bridge, some four or five spans of 100 feet, for $2,000. It was a very cheap structure, and when it was done it looked cheap. Just at the present time, on account of the way the piers were built the ice has dammed against the end of the bridge and practically made an ice jam. It will be somewhat interesting to see the result of this. The bridge was built under the Council's personal supervision.

The President—You see the advantage of this new Bill; it will cut all these gentlemen out from doing this kind of work.

Mr. McPherson—We had also an iron bridge to put up in the Town of Galt. We put steel trusses in and floored it with white oak. We can get white oak in that section easily. We got it last year at $17 per thousand, and the mason work that we put in was dimension stone masonry; we had it done for $6.75 a cubic yard. It is Longford stone. We had quite a bit of competition. It was well advertised and the prices went up to about $15 per cubic yard. We had a law suit in the town about three years ago. Mr. Bowman was acting as one of the expert witnesses. A road had been cut down some ten inches so as to allow the water to be diverted from its first course, and it cost the town something about $1,000 before it was settled. They decided to put in a surface drain to drain the section. This we put in for something like $600, so we found law suits in excess of that sum somewhat expensive. These are instances of mismanagement by Municipal Councils.

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RAILWAY LOCATION WORK.

By J. D. EVANS,

Toronto.

When running preliminary or trial lines for railways it is customary to use the transit. In a country more or less wooded and broken a more expeditious method is with an ordinary surveyor's compass, but to do so in the usual way of prolonging a line with the sights, but more particularly in a section where there is local attraction, would not be sufficiently correct, as the line must be straight.

To overcome the effects of local attraction and other errors of alignment incidental to running with the sights, the lines can be run with pickets by the eye, or, better still, with the aid of a binocular field glass, thus insuring the lines being reasonably straight from end to end, but if in passing over a sharp ridge or narrow, deep valley, where, owing to obstructions, the line cannot be seen for a sufficient distance, an angle can be introduced and thus avoid a possible error in alignment.

To ascertain the angle of deflection, a hub is driven in the ground in the usual way. A compass is set over it (preferably a 4 1-2 in. compass with a 3 1-4 in. needle and folding sights set up on a Jacob staff), and the bearing taken of the line to the rear, and the bearing noted in the field-book as the back sight. The bearing of the forward line is then taken from the same point and entered in the field-book immediately over the back sight entry as the fore sight. These are placed, say, on the left hand side of the page of the field-book. From these can be computed easily the angle of deflection, which is then placed on the right hand side of the page in the usual manner. The angle thus formed is sufficiently correct for all practical purposes and the possible error from local attraction eliminated.

A line run in this manner can be done by a good picketman. The chainmen can keep up near the end of the line marking the broken distances on the hubs, while the transitman, or, as in this case, the compassman, follows, reading the bearings of both lines at each turning point or deflection angle and taking the topo-

graphy. Meanwhile he carries his compass, thereby saving an extra man to carry the transit.

In order to check the angles and prepare for plotting from bearings, the bearing of the first line is assumed to be correct (if it has not before been correctly ascertained), and the bearings of all the lines recalculated from the deflection angles.

DISCUSSION.

Mr. Foster—I have used the same method in traversing, and when sides exceed even 30 chs., and with the distance measured by a micrometer across quite a sheet of water, possibly 15 to 30 chains, I have found it plot in to half a chain, and, strange to say, the interior angles when checked would come within ten or fifteen minutes.

In running out small mining locations a quarter of a mile a side, 40 acre locations, I have often come out within three links and sometimes a link and a half.

The President—I have run lines for a mile and a quarter for stakes, and run close to the side of the stake. I have spent two days in running a line, and when I got through to the rear, cutting through swamps and over hemlock ridges, have come out beside the stake.

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THE CALCULATION OF STRAINS IN BRIDGE TRUSSES.

By JAMES WARREN.
Walkerton.

While all our large bridges require very difficult and intricate calculations and a knowledge of the higher mathematics, yet many of our smaller bridges can be calculated for and designed with an ordinary knowledge of certain principles, by one who has not studied the subject thoroughly, nor had the privilege of attending our School of Practical Science or such like institutions. The determining of the strains in our ordinary bridges is very simple and within the grasp of those who have not had the advantage of higher training. The design of this short and crude paper is to show the manner in which I run over the strains, etc., of plans and designs submitted to me by our County Council when receiving proposals for building bridges, and I add a calculation for a Whipple truss for an illustration of calculation.

Our bridges are now chiefly made of steel, it having superceded iron to a great extent, and will soon almost entirely supercede wood. Steel being so much stronger than iron, a bridge can be built with much less weight than formerly, yet the design must be carefully made, so as to have the required strength, as the loads are much heavier than formerly on account of so many traction engines being used. In order to properly calculate the strains on each part of the bridge, we must arrive at some way of determining how much of the weight is transmitted to each abutment, and how much is carried or sustained by each member thereof. If a weight is in the centre of the bridge, then one half is borne by each abutment, but if the weight is 30 feet from one end of a bridge 100 feet long, then 7-10 of the weight is carried by the abutment nearest the weight, and 3-10 by the other. In this way we can determine how much of the weight has to be carried by each abutment, but we must also find out the weight that is carried by each member or the strain on them. The tendency of the weight is to act perpendicularly, but it does not always act so in each case, as in some members it acts horizontally and in others diagonally.

This can be illustrated very simply by having a weight hanging by a cord, which if allowed to be free, the strain on the cord is equal to the weight, but if we have a weight, say 100 lbs., hanging by a rope from the top of a high wall, and we place a strut of five feet between the rope and the wall, twenty feet below the point of support, then the strain is more than 100 lbs. on the rope, or if we place a strut thirty feet long horizontally from the same point (our rope being long enough), then the strain on the rope is still greater. These strains are in proportion to the sides of the triangles formed. This experiment may be made on a small scale by an ordinary spring balance, if such can be obtained. The proportion in the cases cited are as follows

20 ft. : 5 ft. : : 100 lbs. to 25 lbs., strain on strut.
20 ft. : 30 ft. : : 100 lbs. to 150 lbs., strain on strut.

and by the same proportioning we find the strain on the rope to be 103.05 lbs. and 180.25 lbs. respectively, and proportionally to any other weight or load used both on rope and strut. So, if we want to find the strains on any horizontal member caused by a diagonal member, we multiply the vertical components by the tangent of the angle the diagonal makes with the vertical, and the strain on the diagonal by multiplying the vertical component by the secant of the same angle, and we have the tangent and secant calculated. They are used as constant multipliers in the whole of the calculation, for each panel of the bridge, that is, if the diagonals and struts are of the same length as in the Pratt or Whipple trusses.

The strain on each member of the bridge varies as the load is moved, but each panel must be able to carry the weight placed on it according to the position of the load. While the vertical components differ in each panel, yet the tangent and secant remain always the same in the Pratt, Whipple, or Howe truss, as the diagonals are always of the same length and inclination.

Let us now take a Pratt truss and run through the calculation.

Take a bridge 150 ft. long, 10 panels 15 ft. each:

and try to apply the methods :

Dead load - - -	800 lbs. per foot.
Live load - -	1500 "
	Total 2,300

Panel D. L. 800 × 15 = 12,000
Panel L. L. 1,500 × 15 = 22,500 = 34,500 lbs.

Panel D. L. per truss - - 6,000 lbs.
Panel L. L. per truss - - 11,250 = 17,250 lbs.

The tangent and secant found are as follows and are used as constant multipliers of the vert. components:

Pan. 15, height 20 ∴ tan $= \frac{15}{20} = .75$

Ab. $= \sqrt{15^2 + 20^2} = \sqrt{625} = 25$. Sec. $= \frac{25}{20} = 1.25$

The weight of the structure must be estimated before the calculation can be made, and is supposed to centre at the lower panel points, and the weight of the truss then need not be taken into account here, and to simplify the calculation the D. L. and the L. L. may be taken as one quantity. In the web strain the D. L. is uniform and extending over the whole bridge, while the L. L. is only at one part, so that the strain on each has to be determined separately. To ascertain the chord strains we have at each panel point the truss weights 17,250 lbs., and there being nine of these to be supported by the structure and spaced equally, one-half of the entire load goes to each abutment. F being the centre, we have half going from this point to each abutment. As the load cannot travel directly by the tie-rods, it must go diagonally and vertically along the diagonals and struts, so that each diagonal and strut gets half the load. The same will apply to the load at E, besides carrying the load from F, then the parts at E have to carry 1 1-2 F, etc., etc.

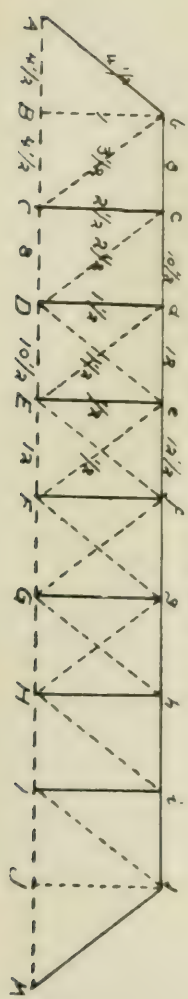
We get the strain on the bottom chords by multiplying the vertical component by the tangent of the angle A, b, B, in the same way as by the weight at the wall, and multiplying by the loads as marked on the sketch. We see, then, that the compression of the top chord and the tension of the bottom chords are equal at the corresponding members: bc - CD, cd = DE, de = EF.

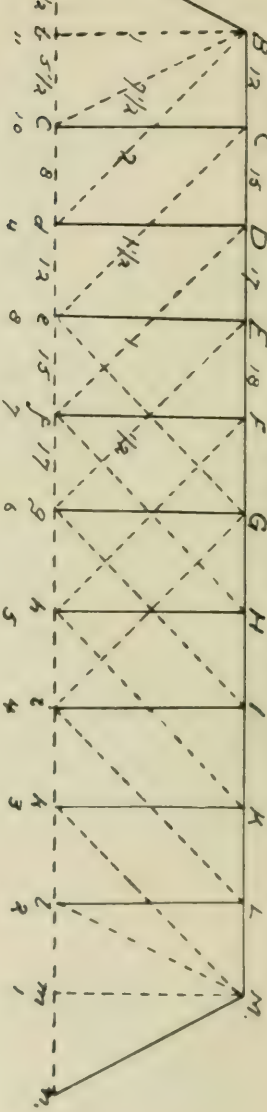
There are other points further that ought to be explained, but as it would make the paper too long I just add the calculation of a Whipple truss, which is made a little different than that for the Pratt truss. Yet the same general principle is used, and the result may be relied on. I enclose herewith two sketches for reference, in which the black lines represent tension and the dotted lines represent tension.

CALCULATION FOR WHIPPLE TRUSS, SPAN 180 FEET.

D. L., 800 lbs. per lineal foot. L. L., 1,600 per lineal foot. 12 panels, 15 ft. each. Height, 25 feet.

15 × 800 = 12,000 = 6 tons pan. Load D.L.) 18 Tons. pan. load,
15 × 1,600 = 24,000 = 12 " " L.L.) Total load.


PRATT TRUSS


WHIPPLE TRUSS.

$\frac{15}{25} = \tan \theta = .6$ | $aB = \sqrt{15^2 + 25^2} = 29.1547$

$\frac{30}{25} = \tan \theta' = 1.2$ | $Bd = \sqrt{30^2 + 25^2} = 39.0512$

$\frac{29}{25} = \sec. \theta = 1.166$ | $\text{Sec. } \theta' = \frac{39.0512}{25} = 1.562$

$aB = 5\frac{1}{2} \times 18\,\tau \times 1.166 = 115.4\,\tau$ compression.

$bB = 18\,\tau$ . . . . . $18\,\tau$ Tension

$BC = 1.166\,[2\frac{1}{2} \times 6\,\tau + \frac{31}{12} \times 12\tau] = 1.166 \times 46 = 53.6\,\tau$ "

$Bd = 1.562\,[2 \times 6 + \frac{25}{12} \times 12] = 1.562 \times 37 = 57.8\,\tau$ "

$Ce = 1.562\,[1\frac{1}{2} \times 6 + \frac{21}{12} \times 12] = 1.562 \times 30 = 46.9\,\tau$ "

$Df = 1.562\,[1 \times 6 + \frac{16}{12} \times 12] = 1.562 \times 22 = 34.4\,\tau$

$Eg = 1.562\,[\frac{1}{2} \times 6 + \frac{13}{12} \times 12] = 1.562 \times 16 = 25.0\,\tau$

$Fh = 1.562\,[0 \times 6 + \frac{9}{12} \times 12] = 1.562 \times 9 = 14.1\,\tau$

$Gi = 1.562\,[-\frac{1}{2} \times 6 + \frac{7}{12} \times 12] = 1.562 \times 4 = 6.3\,\tau$

$Hk = 1.562\,[-1 \times 6 + \frac{1}{12} \times 12] =$ a minus quan. ∴ not requ'rd

$Cc = 1\frac{1}{2} \times 6 \times \frac{21}{12} \times 12 = 30\,\tau$ compression

$Dd = 1 \times 6 \times \frac{16}{12} \times 12 = 22\,\tau$ compression

$Ee = \frac{1}{2} \times 6 \times \frac{13}{12} \times 12 = 16\,\tau$ compression

$Ff = 0 \times 6 \times \frac{9}{12} \times 12 = 9\,\tau$ compression

$Gg = -\frac{1}{2} \times 6 \times \frac{7}{12} \times 12 = 4\,\tau$ compression

$ab = bc \quad 5\frac{1}{2} \times 18 \times .6 = 59.4\,\tau$ tension

$cd = 8 \times 18 \times .6 = 86.4\,\tau$ tension

$de = BC = 8 \times 18 \times .6 + 2 \times 18 \times 1.2 = 129.4\,\tau$ tension

$ef = CD = 8 \times 18 \times .6 + 3\frac{1}{2} \times 18 \times 1.2 = 162.0\,\tau$

$fg = DE = 8 \times 18 \times .6 + 4\frac{1}{2} \times 18 \times 1.2 = 183.6\,\tau$

$EF = FG = 8 \times 18 \times .6 + 5 \times 18 \times 1.2 = 194.4\,\tau$

Check—on above, Max. Chord Strain:

$$= \frac{Wl}{8h} = \frac{(18\,\tau \times 12 \text{ pan})}{8} \times \frac{(12 \text{ pan} \times 15)}{25} =$$

$$= \frac{972}{5} = 194.4\tau \text{ as above,}$$

showing the calculation to come out correct.

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SOME INCIDENTAL BENEFITS FROM THE GROWTH OF FORESTS.

By THOS. SOUTHWORTH, Clerk of Forestry, Ontario.

Toronto.

Mr. Chairman and Gentlemen,—On considering the true meaning of the title of my subject, it has occurred to me that what are the main and what the incidental benefits of forest growth to the community depends largely upon the point of view. The guardian of the public health would probably have no doubt that the principal use of forests was to purify the air by absorbing carbon dioxide and exhaling oxygen, and in regulating the temperature.

The scientific agriculturist would be inclined to think that the chief function of a forest was to serve as a windbreak and shelter for farm crops, and assist the subterranean irrigation, while the old-fashioned farmer will be equally certain that the only use of trees is to furnish fuel and fencing, and they should only be grown so long as they are cheaper than substitutes; failing in this they should be cleared off to provide pasture or plowed fields. The engineer will be inclined to regard trees growing in mass to be chiefly valuable as a regulator of stream flow and a flood preventative, while the artist will look at them mainly from an aesthetic point of view, as making or marring the landscape, according to their presence or absence and thereby contributing to the sum total of human happiness.

Many land surveyors, I have no doubt, frequently have occasion to regard a forest as an unmitigated nuisance, especially when it is composed of Ilex verticillata, or black alder, and lies in the line of march.

As an official of the Government, interested in maintaining the Provincial revenues from sources remote from direct taxation, I have to admit that my own point of view is largely an utilitarian one that regards the forest as a source of wealth to the Province and to the people, but I fully recognize the importance of the other, and what I shall call the incidental benefits, benefits so great and so important to the general welfare of the community as to make it desirable that forestry should be an affair of the State rather than of individuals, with whom present financial neces-

sities may cause a sacrifice of future profits and result to the detriment of climatic conditions.

Before going into the matter of the incidental benefits of forest growth, allow me briefly to refer to what I consider the main question from the standpoint of Provincial revenue, and the maintenance of the extensive industries dependent upon forest products. The Provincial revenue received last year from woods and forests by way of ground rent and timber dues was over $981,000. This represents the production of a large amount of timber, and if we add to this the large quantity of fire-wood, railway ties, pulp-wood, and about 375,000,000 feet of timber cut yearly on lands not controlled by the Crown, it will be seen what a very important part in the industrial life of this Province is played by our forests and their products. The number of men employed in the woods, on the streams, and in the saw-mills, apart altogether from those engaged in other industries dependent in part or wholly upon the forest, runs into the thousands, while the capital employed represents many millions.

It is not necessary for me to go into the many reasons why permanent forest industries must be dependent largely upon State control, that is, I think, pretty well understood by everybody nowadays, but I desire to point out what the present forestry policy of the Government means to the future revenue and the industrial life of the Province.

FOREST RESERVES.

The Forest Reserves Act of 1897-8 proposes to set apart areas of non-agricultural lands to be withdrawn from settlement and kept permanently the property of the Crown for the purpose of growing successive crops of timber. If these areas had to be cultivated and planted to young trees, at an expense of about $15 an acre, the amount of money required would be very great, and if the amount thus expended, with interest, were added to the annual cost of care and protection of the young trees it is doubtful if the resultant crop would show a very large profit on the transaction. True, the crop would be larger than in a forest grown under natural conditions, as was the one we are now harvesting, and a shorter time would be required to enable it to reach a state when it would be profitable to cut it. At the same time the initial expense and annual charges would be so great as to render the project of doubtful financial success on any large scale in this country, where only the more valuable products of the forest have a market value.

Fortunately for us, however, this is not necessary to provide future crops of trees and of the sorts experience has proved to be the most valuable. To do this will require the expenditure of very

little money, but more time. I hesitate to make any remarks as to how we are fixed in the former commodity—it is more or less a political subject, on which doctors differ—but we are rich in the latter. How much money we can invest in re-foresting without borrowing I will not attempt to say, but we have plenty of time. The nation never dies, or hardly ever, and we are a young nation, with millions of acres of land valuable for growing trees, of little value for any other purpose, so we can afford to wait to allow nature to restore the magnificent forest removed by axe and fire from these lands. And nature is already doing the work; not as evenly as we could wish nor with a crop of pure white pine, our most valuable tree, but she is doing the work just the same. I had occasion this past summer to examine a tract of several thousand acres that had been lumbered over, and burned over several times. Over this tract I found a vigorous growth of poplar, birch, white pine, red pine, tamarac, cedar, maple, and other trees. In some places there was very little pine, but over most of it there is a crop of pine numbering from 200 to 700 trees to the acre and growing very fast. Much of it is now 6 to 9 inches in diameter, and I estimate that in 50 years there will be a very heavy crop of pine ready to cut, not less than 50,000 feet B. M. to the acre. I do not mean that it would be wise to cut that much at that time, but it could be cut.

On much of the abandoned farm lands in New England 50,000 feet to the acre is now standing, and two years ago the Rathbun Co. cut 100,000 feet to the acre over quite a tract in Grimsthorpe. I mention this to show that my estimate is not excessive. The stumpage value of that pine 50 years from now will be worth not less than $4 per M, and is likely to be worth more. At this figure the pine timber on much of this land 50 years from now, if protected and cared for, will be worth $200 per acre, which represents a present cash value, at 3 per cent. compound, of $45.62 an acre, and this land is generally considered of no value.

INCIDENTAL EXPENSES.

The main benefit to be expected from these reserves consists in the Provincial revenue and the maintenance of industries dependent on them, but in addition to this the incidental advantages from the presence of these masses of trees are of vast importance to the people of this country. Concerning these factors in forest value there is room for considerable diversity of opinion, and this diversity exists. It is claimed by some forestry advocates that forests materially affect the rainfall, while, on the other hand, it is claimed that it is not so, but that the rainfall affects the forests. While there can be no doubt of rainfall affecting the forests, it is

not equally certain that the presence of forests influences the amount of rainfall. It is a case of not proven, although to my mind the evidence mainly goes to show that if the total rainfall is not influenced by tree growth, its distribution is. We know that trees take up immense quantities of water from the soil and transpire most of it through the leaves. The moisture thus transpired from a large hardwood forest is very large, though difficult to estimate accurately, as the amount varies with the thickness and number of the leaves, amount of water in the soil and other conditions. A conservative estimate, made by F. B. Hohnel, a German scientist, of a fifty or sixty year old beech forest, for the season of growth, places the transpiration at 1,972,000 lbs., or 986 tons of water per acre. Some authorities make the amount much larger than this, but in any event there is sufficient to lead one to believe that the atmosphere immediately above a forest must be so charged with moisture as to hasten precipitation in clouds that may come in contact with it. That forests exercise a beneficial influence on the climate of the neighborhood there can be no doubt. The temperature of the air in the forest is cooler during the day and warmer during the night than in the open field. Consequently air currents are set in motion by this difference in temperature, cooler currents coming from the forest during the day in the lower strata and warmer air during the night from the upper strata, thus equalizing the temperature and increasing the humidity of the air. This is aside altogether from the mere windbreak action of the forest, which is of considerable importance.

WATER SUPPLY.

The aspect of forest growth most likely to appeal to the members of this association is its effect as a regulator of our water supplies, and a factor in flood prevention. Even here there seems to be a difference of opinion and a Western States writer a short time ago claimed that the presence of forests in the mountains prevented the snow from drifting into immense banks and then gradually thawing all summer, keeping up a constant supply of water for the streams. Without disputing this statement, for it cannot possibly apply to our own Province, which is not mountainous, I may state as an accepted fact that the main factor in our great wealth in water-powers and navigable waters are the great forests. At the risk of repeating what you may already know better than I, I desire to point out some ways in which the forests serve to regulate the flow of streams and prevent alternate flood and drought. Speaking generally, the stream flow can only reach a percentage of the rainfall in the catchment basin. If the water does not fall either as

rain or snow there can be no streams; but, granted a certain precipitation during the year, it may be gradually given off to the streams, making them reasonably constant in volume, or it may run off quickly, causing a flood and subsequent drought. Our streams are fed in two ways, by underground springs, and by the run-off from the surface of rain or melted snow. Springs occur generally where a layer of porous sand or gravel lies between an impenetrable subsoil and the surface soil. The rain-water runs under this top soil through the sand or gravel, and as it cannot penetrate the subsoil it is forced out through an opening in the top soil and goes to add to the volume of the nearest stream. It will readily be seen that a larger quantity of water will reach the gravel layer if the surface is covered with forest than would be the case in the open field, as most of it would run off the surface after rain, in the latter case, instead of soaking into the soil. Most of us have known of springs that have become dried up in the summer, that years ago, before the woods had been removed, were perennial.

In the same way the forest serves to regulate the water running from the surface into the streams. Concerning the extent of this action of the forest a great deal has been written pro and con, and volumes of figures have been compiled to show that the removal of the forest had little or nothing to do with stream flow. At the same time I think we are all pretty well convinced that Captain Eads, the famous engineer, was right when he remarked concerning the building of the jetties at the mouth of the Mississippi River, that he was working at the wrong end of the stream. The very nature of a forest floor covered with small twigs, leaves, and sponge-like soil, indicate the mechanical action that dams the water and allows it to run off slowly. Branches die and fall to the ground. Trees do likewise, and in falling across streamlets would form dams and create small reservoirs of water against the time when it would be needed. The roots of trees also form conductors that allow the water to penetrate the subsoil deeply, and add to the subterranean supply. Remove these forests and the rainfall rushes off to the streams, which are soon in flood and soon dry up. The snow exposed to the full force of the wind and sun follows the same course, and large sums are being spent all over the continent to prevent the disastrous floods that now cause so much damage and loss of life, but which were not known in the earlier days when this was really a "wooden country."

At Brantford, I believe, they are spending a large sum of money to prevent the annual flood of the Grand River, doing so much damage. It is worth noting that the county of Brant has only about 7 per cent. of its total area classed as woodland, and of this, much is not true forest land, but is pastured and the soil beaten hard. Most of you know something of the vagaries of the river

at Belleville, which nearly every spring causes anxiety as to the amount of damage it is likely to do in flood and in summer is so dry as to cause the remark by a traveller who saw it last fall from a Grand Trunk car that "it looked like a first rate place to put a river in."

A concrete case of the effect of forest denudation on stream flow has been furnished by W. C. Caldwell, M.PP. Mr. Caldwell is a lumberman and a mill-owner, and as his business interests were affected, he made careful notes of the occurrence in his diary at the time. The watershed of the Clyde River was swept by successive fires in 1875-6-7, a large territory being affected. The water supply was gradually affected from 1880 to 1885. From 1885 to 1892 the flow of water was so reduced that in 1886-7-8-9 and 90 the mills on the Clyde were short of water in August and September, something unknown until that time. In the meantime the new crop of poplar, birch, etc., had reached quite a size, and in 1890 began to affect the water supply and restore the evenness of flow. Since 1893 there has been an abundant supply of water, and Mr. Caldwell has no doubt it is due to the effect of the new forest that has followed the fires. Failing this new forest, a constant supply of water could only have been secured by a costly system of impounding reservoirs.

I feel that I owe the members of the Association an apology for wearying them by these rambling remarks on a thread-bare subject, but will simply urge in extenuation that in many of the older counties the percentage of forest is far too low, and you, gentlemen, are able to accomplish much in restoring the proper balance.

TREE NAMES.

Before sitting down, I would like to refer to a subject discussed last year—the proper naming of our forest trees. I think you all agreed with me that the local names were sometimes confusing. Well, I still have a complaint to make. I had the privilege of looking over a report made by one of your prominent members recently, and in it he refers to a tree which he calls "Pitch" pine. As the Pitch pine—Pinus rigida—is not native of this Province, I have not yet learned whether he means Banksian or Jack Pine, Norway or red pine, or whether he classes all undergrown, scrubby pines, of whatever sort, by that name. I suppose I might have asked him and found out, but preferred to do so in this way, as I believe he last year expressed himself as thoroughly in favor of the correct naming of our forest trees.

DISCUSSION.

Mr. Morris—In regard to the growth of white pine, where the trees are from six to eight inches, the statement is made that in 70 years 500 trees will give about 200 feet to the tree, 100,000 feet to the acre.

I know a case where in about 25 or 30 years a patch of about ten acres of what they call cypress, a small white pine, increased from two or three inches in diameter to from twelve to fourteen inches in diameter. The land is a sandy soil, and I am sure that after 50 years growth those trees will give a much larger return than you state in your paper. Those trees that are six to nine inches in diameter now I have no doubt in twenty-five years will give the quantity of lumber you mention. It may depend upon the soil, but white pine grows best usually in a light sandy soil. They grow as a rule on the higher lands in the sandy soil. Fifty years I thought was a long period to give a tree to grow to about sixteen or seventeen inches in diameter. I do not know whether the growth would be much slower at that size than when from six to nine inches.

Another point is in regard to the pitch pine. We find what we call the pitch pine when we get up west of the surveyed territory now. The present surveys in Algoma and Nipissing stop about where the pitch pine began. When you get up towards Missinabi you get into the pitch pine, but there is a pine on the plains in a great part of this country where the land is very poor, a scrubby pine, not a pitch pine, but it is called pitch pine. The limbs begin at the ground and they grow very stunted. It is not the pitch pine we get further north.

Mr. Southworth—There is no true pitch pine in the Province as a matter of fact.

Mr. Morris—It is a pine, a scrubby pine, which we find in the northern latitudes, before you get out of the heavy timber of any kind, a pine that grows with a scaly bark on it.

Mr. Southworth—I think that is the jack pine.

Mr. Morris—Yes, it is the jack pine. Sometimes it is called pitch pine.

Mr. Southworth—And also other pines are called pitch pine.

Mr. Morris—The pitch pine is a small scrubby pine which grows up in burnt districts where red and white pine have grown before.

Mr. Southworth—We have really only three pines native to the Province.

Mr. Dickson—In regard to this scrubby pine, I used to think it was pitch pine, but I believe the proper name of it is jack pine. I find it scattered over all the northern parts of the Haliburton district, extending out to the Ottawa. Large tracts of it occur down to the Petewawa. Up here it is called jack pine, and in the North-West and Manitoba it is called cypress, or "cypres." Out in your district, Mr. Morris, at the north end of Wendigo Lake, a little west of the portage on the north boundary of the Township of Fitzgerald, I found a growth of timber I believe to be jack pine. I found also a growth of timber, perhaps 50 or 100 trees, as much as fifteen inches in diameter and 50 feet high, I thought was pitch pine.

The President—In reference to this prospective growth of pine, Taylor Bros., on the River Don, have an extensive plantation, and they figure on $4 an acre for their land per year.

Mr. Southworth—$4.20 an acre is the net revenue for all the timber country in Saxony. This is the highest return in Europe.

As to the growth of white pine, I would like to say my estimate is an extremely conservative one. Government officials are not in the habit of exaggerating these things, because they are too apt to be called down.

Then as to the district between the Madawaska and the Missinabi waters, when this pine is growing an inch in two and a quarter years it is very rapid growth. I do not estimate on 500 trees an acre, because the land would not stand that number. In the German method every tree gets an adequate space for itself. In this case it is not so. Some places are blank, and some very thick: you cannot get an ideal forest to grow under natural conditions.

At any rate, all through that section I am quite convinced that 50,000 feet to the acre 50 years from now is a very moderate estimate, and I think my estimate of stumpage values at $4 a thousand for white pine is extremely low also. I mention that simply to accentuate the value of these lands, considered utterly valueless. They are worth over $45 an acre to-day, and no one wants them. But it is not proposed to plant. The necessary expense would be so great as to put it out of court, I think, entirely; but there are some of the blank spaces it is a question whether the rangers in charge of this territory might not be able without very much expense to take a little pine seed with them and possibly fill in where some of the plants are not now growing properly.

Referring to the remarks of Mr. Morris regarding these pines, we have really only three kinds in the Province—white pine, red

pine, and the jack pine. I have an idea, just as he says, that there is another species of pine growing in the open, and it is scrubby, and the branches grow down close to the ground. It is indiscriminately called pitch pine, and it may be white pine or jack pine or red pine. The branches always grow down, and as the tree grows they drop off.

Out in the district of Algoma this despised jack pine that is not considered of any value except for fuel and very little for that, makes a very respectable timber tree. I have seen it at Point of Pines, west of Sault Ste. Marie, as large as sixteen and eighteen inches in diameter, and with good clean trunks up to 30 and 40 feet, and it is being sawn for lumber up there and also sold to the railways for ties. It gives a very serviceable, durable timber for the purpose I am told. I have an idea, as suggested to the School of Science, this timber will be found useful for street paving blocks after the English method, and I think that Prof. Galbraith and his staff have promised to take the matter up and test it and see if it is suitable for that. We have immense quantities of it, and it may yet be a valuable tree. This accentuates the desirability of a proper nomenclature for our forest trees.

The white pine has five needles, the red pine two and the jack pine two.

Mr. Dickson—I would like to ask Mr. Southworth what his opinion is about black walnut. There are some sections of the country where it is becoming exceedingly scarce. Could it not be grown over the country ?

Mr. Southworth—Black walnut will grow almost every place in the southern part of the Province; it is grown up as far as Guelph. But it takes a long time to grow black walnut to maturity. A large proportion of the wood is sapwood, which is not very valuable, it is the heart wood which is of value. I do not think you can grow black walnut from the nut and make it commercially valuable in less than 75 or 80 years.

Mr. Bowman—I have seen in Waterloo County black walnut such as you see in New York State, and equal in size, planted from the nut, probably planted somewhere about 1810, and the trees are now large. I think your estimate of 75 years would give you a good big tree about 18 to 20 inches in diameter.

Mr. Southworth—There is this peculiarity about woods: they are unlike most merchantable commodities that become more valuable when they get scarce. This is not the case with wood. Black walnut is not worth as much as it was 15 years ago. It has been

put out of fashion, and they have substituted oak for it. Black birch will take the place of oak without any doubt, in a few years—it is replacing it now very largely, and is sold under the name of Southern Mahogany.

Mr. Tyrrell—I think as Mr. Southworth is not a member of our Association, we might very properly depart from our rule and move a vote of thanks to him as the writer of this valuable paper. I move a vote of thanks. Seconded by Mr. Sewell, and carried unanimously. Mr. Southworth replied to the vote expressing his appreciation of the attentive hearing his paper had been accorded.

The Association is not responsible for any opinions expressed in its Papers by Members.

A TRIP TO THE YUKON AND RETURN.

By LEWIS BOLTON, O.L.S., D.L.S.

Listowel.

Mr. President.—My intention is to give you a short sketch of my trip to the Yukon District and return, and some of the things that I saw while there.

Starting from my home in Listowel in the first week of May last, I purchased a ticket per G. T. Railway and the Great Northern to Vancouver City. I need only say that it was a most delightful trip across the Rockies and the Cascade Mountains in Washington Territory. The scenery was very fine, and I fear that I would fail were I to attempt a description thereof. I had Mr. J. W. Wilson, an old miner, as a travelling companion, who had, some ten or twelve years before taken this same trip into the Yukon country. We took a Tourist Sleeper, and provided ourselves with eatables to last us through to the Coast. We arrived at Vancouver safely, making good time, without any mishaps. We remained here some two or three days, visiting friends and relatives, and indulged in a day's fishing on the Coquittlam River, where my nephew and I succeeded in catching a fine lot of mountain trout. Where is the surveyor who does not enjoy a day's trout-fishing? Here we completed our outfits and took passage on the beautiful ocean steamer "Tartar," owned by the C. P. Railway. We had a very enjoyable trip up the coast on what is called the outer course—that is, going to the west around the point of Vancouver Island, keeping it to our right hand. The smaller vessels take the inner course amongst the islands, where they are protected from the ocean swells. From Vancouver to Skagway is a panorama of scenery on a magnificent scale, and peculiarly charming, into which rare and elusive effects have entered. Marine sketches, land and water combinations, here depressed and there laid and broken shores, backed by recurring benches, densely timbered, and away over all, far off and high up, have risen majestically the tops of mountain ranges, giving on the whole sweep of vision that indefinable charm which "magnificent distances" alone can lend. At times your impressions would be, as it were, dreaming—now weird and calm, and again exhilarating. Sea fowl innumerable, gulls, ducks, geese, and others, were continually with

us. Frequently our attention would be diverted to a spouting whale or a shoal of porpoise. On many of the mountain sides glaciers of considerable dimensions could be seen, from which small icebergs had broken and gone floating southward. We called at Fort Wrangel, our only stop between Vancouver and Skagway. Having an hour or so at our disposal, we took a turn through the village. It was on Sunday, and the inhabitants were in their holiday attire. The aborigines were quite numerous. A number of totem poles were standing, giving the place a weird appearance. All the buildings had been put up with an eye to cheapness, and uncertainty as to long occupation. We were very much entertained during our short stay. We passed several Indian villages and their burying grounds, which were decorated with streamers of different colors and numerous totem poles. We arrived at Skagway early one morning, and then the bustle commenced. There were from one to two hundred on their way to the Yukon country on board, necessarily causing considerable commotion in landing. First, we had to pass customs, after that we made search for a hotel or stopping place. My friend and I selected the Pacific and found it a very comfortable place. After remaining here a day to get information as to which would be the best route to Bennett and as to other matters, I decided to go by the Chilcoot Pass. My friend intended remaining at Skagway a few days, so I packed my transit into shape for carrying, leaving my tripod and other baggage to go later on by pack train, and started for Dyea, crossing the small bay by ferryboat. I landed in Dyea about noon. After lunch I started up the trail for the pass, hoping to reach Sheep Camp by evening, which I did. This place was certainly what I expected to see—a rough frontier stopping place. Nobody was living here for the benefit of his health or for the love of the mountain scenery around it. They were there for all they could make out of the travellers on their way to the Klondyke. Restaurants, stores, hotels, etc., were numerous, and during the past winter, no doubt, did a rushing business. Everything was quiet when I passed through, the rush of travel having been in March and April. After partaking of a hearty supper, I repaired to my "sky bunk," and slept soundly, getting up at an early hour, as I wanted to make Bennett early that evening. The trail from here to the Summit was much steeper than what I had traversed the afternoon before, and my pack of forty pounds or more began to get quite heavy, but to Bennett I had to get. After about two hours' travel I arrived at what is called the "scales," or foot of the steep ascent to the Summit. This is the place where that snowslide covered up so many people and destroyed so much property last spring. Two men had been dug out a day or so before I arrived there, and their bodies were being taken to Dyea by the aerial tramway.

It was supposed at the time that there might be more people beneath the snow, as there was then a great depth, and only the hot sun of the summer months would reveal what was still hidden beneath the snow. This steep ascent would probably be from ten to twelve hundred feet in height, measuring on the incline. Steps had to be cut in the ice and snow to enable one to climb up, and every hundred feet or so you would be asked to contribute twenty-five cents towards the expense of cutting these steps. A life-line was stretched from top to bottom, so that in case you slipped and fell you could lay hold of this line and save yourself from sliding to the bottom. Arriving at the Summit we saw provisions and outfittings of all kinds stacked up like cordwood, as high as it could be reached. Some outfits you could just see the tops of, sticking out of the snow. No person seemed to know what depth it was there, as almost every day less or more fell. There was a report that a man had stacked his outfit there and had gone back to Dyea on business, and on returning a short time after found that his outfit had been covered up. He had taken the precaution before going back to take certain measurements, so that he would know just where to dig for it. After locating his point, he commenced to dig, and shortly came to an outfit, but it did not prove to be his. He then dug on until he came to the third one, which was found to be his. This, however, I will not vouch for, but such is the story told, and not altogether unlikely. This would be about the middle of May. From this point the descent is truly rapid, and lots of snow and ice, but very soft and slushy. The creeks were beginning to break through the snow, and at times there was danger of dropping into holes, whereby you might get very wet. Crater and Long Lakes were getting covered with slush and water, making the travelling very difficult. I arrived at Lake Linderman about noon, and was very much surprised to see the number of people there living in tents and building boats by the hundreds, preparing to go down the river to Dawson and other points. Lake Linderman was open at the head, where the creeks were running in, but the ice on the body of the lake appeared to be sound, and people were travelling on it. I concluded that if it held them it would hold me. I took care to follow on the track of a sled with dogs and a heavy load, and arrived at a point where the lake was open from there to the other shore at Bennett, and took passage in a small boat, landing in Bennett before 5 o'clock p.m., somewhat tired and footsore walking on the rough ice. Bennett at that time was a city of tents—I might say thousands of them, all sizes and shapes. The inhabitants were very busy whip-sawing lumber and building boats. I would say that there would be at least ten thousand people at Lakes Linderman and Bennett preparing to go to Dawson and other points. I remained here about a month assisting my

nephew, Mr. Hawkins, who had the contract from the British Columbia Government for the survey of the town sites of Linderman and Bennett. About the 25th or 26th of May the ice gave way in Lake Bennett, and the people commenced to make their way down the river towards Dawson. At first it was slow work, there being so much ice in the lakes.

It was very difficult work laying out these town sites. The tents were so thick on the ground that we had to wait until a great number of them had started down the river, and even then we had to get the assistance of the Mounted Police. Occasionally we would come across some tent-owner who was not inclined to lower his tent for our accommodation, but on sight of the policeman he very quickly changed his mind. The town site of Linderman had been laid out by some American surveyors, and town lots sold in many of the American cities, but after our police took possession of the Summit at Chilkoot Pass it was abandoned. Bennett is situate in a very picturesque spot at the head of navigation on Lake Bennett. The lake is very narrow, and the mountains on either side are very high. Those to the south are snow-capped until late in the season. The water in Lake Bennett is at its lowest in spring. Many will wonder at this. The snow on the mountains melting in the hot months of the summer causes the lake to rise. Wild flowers were quite plentiful when I arrived there, the lupin being the chief one, and it would be seen almost amid snowbanks. After completing the surveys of Bennett and Linderman, we started for Dawson, in what is known as a knock-down boat, purchased at Vancouver in pieces and put together at Bennett. We also had a Peterborough canoe, which we intended for going up small streams prospecting, etc. There were four of us and about two and a half tons of provisions, etc. The first day we went as far as the mouth of the Windy Arm of Lake Tagish. The next day Mr. Hawkins and I paddled up Windy Arm to complete the traverse of this part of the lake, in order to establish the sixtieth parallel, it being the boundary between British Columbia and the North-West Territory. We found the arm of the lake to be worthy of its name, and were forced to land our canoe and foot it over the mountains and rocky shore seven or eight miles to commence our survey. We then had to traverse the shore northerly until we reached the intersection of the parallel with the shore of the lake, at which point we arrived at midnight, marking a spruce tree with the proper markings to denote such position. This survey had been made to determine whether certain timber limits that had been located were in British Columbia or North-West Territory. After completing the survey we started on our return trip over the rough, rocky shore to our canoe, arriving there about 3 o'clock in the morning, hungry and tired. We finished the remainder of

our lunch and shoved out our canoe and set sail for camp. Having a fair wind, we had a very pleasant trip to camp, arriving there at about 6 o'clock in the morning, just twenty-four hours from the time we started. We took a short nap while the men loaded the boats, and then started down Lake Tagish, calling at Tagish House, a police station, to register. Every person had to stop at this point and give the name and number of his boat and the names of those that accompanied him. Nothing of particular note occurred in our travel until we reached White Horse Rapids, about which there has been so much written. Here there are two horse tramways—one on either side of the river. We decided to take the left hand side, and let our boat gently down to a point where the tram started, and only a few feet from the head of Miles Canon. Here we arranged to have part of our load taken around on the tramcar and the rest taken down through the canon and rapids in our large boat, in charge of a pilot. I decided to walk around, the distance being about four miles, rather than go through the canon and rapids. The rest took chances and went down, and very much enjoyed the trip, according to their account, but I noticed they were quite wet when they arrived at the foot of the rapids. Before leaving the head of the canon I took a seat on the top of the bank at a point where I could see the boats pass through the canon. I had a good field glass, and enjoyed a half hour exceedingly. Boats of all sizes, from a small skiff to large-sized scows, carrying ten to fifteen tons, were passing all the time. One party while I sat there had a very narrow escape while passing through. On entering the canon he either got rattled or made a wrong stroke with his paddle, and ran his boat bow foremost against the wall of the canon and went in sidewise, and before he could get righted the boat struck the other side of the canon and proceeded stern foremost. Part of the time he would be out of my view on account of the height of the waves, and then he would appear again, you would think almost in the air. The boat took another lurch for the side of the canon, striking it and wheeling around right end foremost, and finally shot out at the other end of the canon, the occupant thanking his stars that his boat was right side up and that he was in it. It was rather exciting, and were a person to sit there and watch for a long time it would be a great strain on his nerves. At the White Horse Rapids, about three miles farther down, is another sight-seeing point. Hundreds of people line the banks, watching the boats passing through the canon and down the rapids, very few succeeding in passing without getting thoroughly ducked with spray. I sat for a long time on a rock within fifty feet of where the boats passed, and could see their occupants' countenances while passing through. Some appeared considerably excited, while others were laughing and seemed to thoroughly enjoy the ride.

While sitting at this point I heard a voice up the river, and on turning around I saw the steamer "Ora" coming down at a very rapid rate, crowded with passengers, cheering with all their might. By this time the banks were lined with spectators for almost miles to see the steamer pass through. After she had passed through safely there was a cheer went up, almost deafening. This steamer was built at Bennett during the latter part of the winter and early spring, and after making a few trips from Bennett to the rapids the owners decided to run her from the rapids to Dawson, in connection with the "Flora" and "Nora," they remaining above and running between the rapids and Bennett. After loading our boats we again started down the river for Lake Tagish. That evening we camped at the mouth of the river leading into the lake, in company with hundreds of others on their way to Dawson. Early next morning we set sail, expecting to have a merry trip across the lake, a distance of about thirty miles. At first we had but a very light wind, but by eight o'clock it began to freshen up, and everybody had all the sail up that he or she could muster, and it now became a race for the other end of the lake. By this time the lake was literally covered with craft of all kinds, sizes and shapes, some of which were built on the lines of large hog troughs, and others almost as beautiful as the gondolas of ancient Venice. The people occupying these were from almost all parts of the globe, and seemed to have all been affected by the common craze for gold. When we arrived at the middle of the lake it was a sight long to be remembered, and to complete the grandeur of the scene the pretty little white steamer "Ora" passed through our midst and soon left us in her wake. Every person was straining a point to pass his neighbor, and, with the assistance of the strong wind, were making very fast time. When nearing the northerly end of the lake, which is much more narrow and shallow, the waves became much higher and the small craft began to experience rather a rough time. One canoe, in which the Rev. Mr. Lyons and his companion were, capsized, and Mr. Lyons was drowned, his companion saving himself by clinging to a crevice in a rock until rescued by another boat with very much difficulty. We were very much pleased when we were able to turn our boat into the river and once more into smooth water. Up to this time we had done but very little fishing, and decided to tarry for a short time at the first place offering such sport. Arriving at an eddy in the river, we ran our boat ashore and got our tackle—two took the Peterborough and a troll, and the cook and I took small lines. I selected a small eddy to try my luck in, but found the brush on the bank rather troublesome, but after breaking a few off I decided to cast my flies for a skip, and soon succeeded in raising a commotion in the water. Two and sometimes three at a time were common. The cook came to

my rescue just in time to save my rod and line, as I had fastened onto three very large Arctic trout, and with his assistance landed them safely. We now had all we could carry, and returned to the boat, finding that I had been the only one successful in catching any fish. That evening we had a grand feast of fresh fish. From this point down there was nothing of particular note excepting passing through the "Five Finger Rapids," which is easily done if proper care is taken to keep your boat in the current and in the right channel. Very few Indians are to seen along the river. At the mouths of all the streams running into the Yukon were villages of tents, owned by prospectors who were up these streams prospecting, leaving their wives and children to take care of their belongings until their return. There were all kinds of reports as to great strikes on certain creeks, but on careful enquiry it was found to be untrue. The trip down the river was like a holiday picnic. At every turn of the river we would make new acquaintances. We travelled somewhat faster than the average voyageur. The scenery on the lower part was quite equal to the upper part. The mountains were not quite so high, but the grass had grown more and the mountain sides were like flower gardens, and were even more brilliant than ours in Ontario.

Fort Selkirk was at last reached, and we halted for dinner. The banks were so crowded with boats that we were unable to land near the village, and therefore did not see much of it. A few log buildings covered with dirt comprised the barracks of the Mounted Police, but there were hundreds of tents of all colors and shapes, and the red-coats could be seen promenading the banks of the river. We tarried here but a short time, having still about 180 miles to Dawson. From this point commenced what are known as the Ramparts, which appear like huge towers built of masonry, being in many places so regular. Prospectors now began to come up the river, and could be seen towing their canoes with small outfits, the current being so strong that they were unable to row them, and proved at best a very slow process. We arrived at Dawson in the evening of the 29th of June, making the trip of over 500 miles in eight days. Dawson appeared very pretty at a distance. On turning the head of the river it appeared as nestling on the mountain side and at its foot. Everything appeared white and distinct, with the mountain background. There were thousands of tents, many even on the top of the mountain. It was estimated at the time of our arrival that there were between twenty and twenty-five thousand people there. We secured a place near the police barracks to put up our tents, and at the close of the second day we were established in Dawson ready for business. Our first work was the survey of a Government concession on Hunker Creek, about fifteen miles out from Dawson. We packed our

instruments out and completed the survey in about a week, and returned to Dawson from the mouth of Hunker Creek by small boat, plied by two young men who took freight up to that point and passengers down to Dawson. We rented a small room above a restaurant for an office, paying $100 a month therefor. The building was made of scantling covered with canvas. After completing the plans of the survey we made our headquarters at the Forks of the Eldorado and Bonanza Creeks, about twelve miles from Dawson, and between there and Dawson I spent the summer, surveying claims, etc. To speak of the richness of the individual claims would be hard to do, but suffice it to give you a few of the notable ones. No. 2, above on Bonanza, is probably one of the richest. It now has been floated on the English market for the fabulous sum of £450,000 by the owner, Mr. Alexander McDonald, known as the Bonanza King. He was interested in some one hundred and twenty claims. Nos. 4, 5, and 6, on Eldorado, are also very rich, and are known as the Berry Mines. One day while passing I called to see the owner, Mr. Berry, who was at the time in the bottom examining a part that was considered not to be worth washing. While watching him he struck his pick against a nugget that proved to be worth $140. It has been estimated that about a million dollars have been taken out already, and the claims are not nearly worked out. The "Lancaster," a bench claim opposite No. 3 Eldorado, is considered to be one of the richest bench claims. It is claimed that two men can take out $1,800 to $2,000 a day with one rocker. One day while visiting the mine we offered the owner $150 for a small wheelbarrow of dirt that was standing by the rocker, but he would not accept it, and found on washing it that it yielded about $250. French Hill is also considered to be very rich. Some of the claims (one hundred feet) having been sold for as high as $20,000. Most of the claims on Eldorado up to No. 30 are very rich, most of them being valued from $200,000 up to $500,000, and some were more. Part of the Bonanza is also very rich, but is more spotted. The bench claims along the Bonanza are in many places quite rich, and during last summer a great deal of gold was taken out. The gold on the Bonanza is considered to be worth considerably more than that of Eldorado, being much finer. I cannot say anything in reference to other creeks, so far as my own observations go, as my work was principally on those two creeks, only visiting Hunker once, and then not when it was being opened up.

The summer was delightful, sunny days and cool nights. Many of the miners slept during the midday heat and worked in the cool at night, there being plenty of light. One could read in a tent at any time during the night. Wake up at whatever hour of the night, you would hear the "wish wash" of the rocker, and the

rattle of the gravel off the shovel, and the tramp, tramp, tramp of the miners and others coming and going to Dawson for provisions, the night being the most comfortable time for travelling. The weather during my stay (which was about three months) was delightful—very little rain and very little cloud. Two weeks in July were quite hot, but with that exception it was all that one could desire. Towards the latter part of September it turned a little cool at nights, and I decided to arrange for my return before the close of the month, and took passage on the steamer "James Domville," that had been plying on the lower river during the summer and was intending to winter on the Upper Yukon. They had advertised to go to the White Horse in six days, but did not arrive at that point until fourteen days had been spent, a good part of which had passed while on sand-bars, and tied up against the bank for repairs, etc. Our captain knew more about the smell of a whiskey bottle than he did about navigating the Yukon River. We had paid $100 for passage to White Horse, and were paying $1.50 for meals, so a matter of two weeks or so on board the boat was quite a consideration. At the end of six or eight days from the time we left Dawson many of the passengers refused to pay anything more for meals, as they had exceeded their time, but the captain said they had to pay or go without. However, the larder began to get rather low, and the meals consequently poor, and there was a general kick, and most of them did not pay. Our berths were rather small, six berths in a state-room 7 by 7. Only one could dress or undress at a time. There were about one hundred and fifty passengers, chiefly miners going home after a year and a half's trial in that frozen north, to visit their families, intending to return in the early spring and some on the ice in late winter. We had a full quota of gamblers, both male and female, who indulged in that every night until the tables were required for the morning's meal, and then slept through the day. The weather during the return trip to "White Horse" was cool but fine. Some nights there would be a slight fall of snow on the mountain tops, but on the first peep of the sun it would melt away. We arrived at the White Horse Rapids early one morning to find that the steamer "Flora" had been gone about an hour. Perhaps the passengers were not disappointed! We then gave our captain credit for stopping five miles down the river the night before so that we would miss this boat and have to remain until the return of the boat some three days later. The captain had a very stormy interview with some of the passengers before disembarkation, and had to retreat to his pilot house and arm himself with his gun in order to save himself a cold bath in the river. Our stay of three days at "White Horse" was very irritating, considering that we could have caught the other boat if our captain had done his duty.

Here we had to pay $1.50 to $2 for meals and had also to pay for sleeping on the soft side of a plank on the floor of the hotel, or stopping place, but by this time we were used to being held up, and took it as a matter of course. It was a bright hour when the steamer was sighted, and a glad shout went up from many throats, and in a short space of time we were all ready to board the steamer, in fact much sooner than they were ready for us. We had to walk a single plank in order to board her, and a misstep meant a cool bath in ice water. In a short time we managed to get on board and obtain our sleeping berths, about 2 feet 6 inches by 6 feet each, made of hard spruce lumber, not even a straw tick in them. However, we were now so anxious to see the Pacific coast, and the prospect of so doing became more apparent, we were satisfied with anything as long as it was moving in the right direction. Our chances for meals in this craft were rather uncertain. The table had to be filled some nine times before the passengers were supplied. Some went without rather than participate in a scrap for a seat thereat. Most of the distance from "White Horse" to Bennett is through lakes which are literally covered with water-fowl. Many of the passengers indulged in shooting at them, very seldom killing any. We arrived at Bennett at noon of the second day from "White Horse," glad to once more put our feet on terra firma, having been so long on the water. After dinner we hurriedly made arrangements with the representative of the Arctic Express Company to take our baggage to Skagway at ten cents per pound, guaranteeing their delivery there the following day on the arrival of the evening train from White Pass City. After completing this, we started on foot for the "Log Cabin," some eight miles distant on the trail towards Skagway, via the White Pass. Some of the passengers went via the Chilkoot Pass, in order to see it, but I had come in by that way, and preferred going out by the White Pass. We arrived at our destination at dusk, and after a lunch, as such it was, we decided to try sleep. My companion and I were assigned the lower bunk of the series, at the end of the cabin. These bunks had been built with small poles, on the top of which was laid a not very thick blanket, no tick or mattress, with a light blanket to cover us. It is needless to say that I kept most of my clothing on. I found on getting in that the poles were not all of the same size, and that a larger one had been placed about the middle of my share of the bunk, on which I tried to balance myself for an hour or two. Failing in my object, I got up and sat by the stove in a comfortable chair, catching short cat naps until an early hour in the morning, when I woke the landlord to get us some breakfast. We started at early daybreak for White Pass City, where we intended taking train for Skagway, a distance of twelve miles or so. By some means I got separated from our

party and trudged it alone. The day promised to be fine, but by the time I began to ascend the mountain side clouds began to appear about the summit, and as I rose up its side I found myself being enveloped in them, and was completely shut in, not being able to see more than ten feet or so ahead of me. Snow and rain began to fall, and with what had fallen the day before I was more than ankle deep in mud and slush, which was not very comfortable with short boots. I arrived at the summit about midday, and I supposed that the air would soon clear after passing it, but such was not the case. The fog or cloud hung there until I had gone down several miles on the other side. The scenery no doubt would have been most excellent had it been clear. On arriving at the junction of two canons the fog began to clear away, and I was able to discern men and horses on the mountain side, working on the railway. This point was the grandest that I had seen, and I stood for a moment taking in the sights. By this time my feet and legs began to feel somewhat tired, and going down the sides of this steep canon was somewhat difficult, and I was glad when I arrived at the bottom, where the trail had been very much improved. The keeper of a restaurant at that point invited me to come in and have dinner with some of our party, but having taken something on the other side of the summit I passed on. Shortly after one of our party overtook me on horseback, and told me that a chunk of rock had passed through the roof of the restaurant and broke through the floor immediately behind some of our party, who were taking dinner, not hurting them, but at least giving them a fright. The trail now became pretty good, and although tired I made good headway. The scenery along the bottom of this canon was very fine, and under other circumstances would have been very much enjoyed, but with the fear of some rock coming down the side of the mountain from where the workmen were blasting, one was in constant dread. I arrived at White Pass City in due time for the train, and enjoyed myself feasting on some fine apples that I had purchased at five cents a piece, being the first that I had eaten. I heartily enjoyed this ride of twelve miles or so on the train, even if I had to pay twenty-five cents a mile therefor. We arrived at Skagway about 6.30 p.m., and on enquiry found that my baggage, with others, had been left behind. After "cussing" the railway officials and their agent at Bennett especially, we repaired to the Pacific Hotel, where we found comfortable quarters at a reasonable figure. We had now gotten beyond Klondyke impositions, and were able to get a first-class square meal for twenty five cents and a comfortable room for fifty cents to a dollar a day. I remained here a week, not of my own will, but was forced to do so on account of my baggage being detained. I found Skagway very much improved since spring, it having the appear-

ance of a civilized town, having waterworks, electric light, etc. This place, in my estimation, is destined to be one of the largest cities on this coast, being the terminus of the railway leading to that large tract of country known as the Yukon and Lake Atlin District. From this point I took the steamer "Utopia" for Seattle, on which we had a very pleasant trip, rescuing the passengers of the wrecked steamer "Bertchel," who had been detained on an island for over a week. We arrived at Seattle on Sunday afternoon, and enjoyed the trip down the coast that day very much, as the vessel was close to land and the towns and villages were easily seen from the deck of the steamer. I remained in Seattle one day visiting friends and enjoying the sights of the city. This city is certainly one of the finest on the Pacific coast. From here I took train to Vancouver, where I remained a day or so on business, taking the C. P. Railway to Chicago. I very much enjoyed the sights through the mountains, which are well worth the cost and time spent in taking the trip through them. From Chicago I took the Grand Trunk Railway to Listowel, calling on my way at Kingsville and Detroit, arriving home just six months from the time I had left in the spring, having gained considerable knowledge besides what little I had gathered of the yellow metal.

[*The Association is not responsible as a body for any opinions expressed in its Papers by Members.*]

SURVEY OF THE BOUNDARY LINE BETWEEN ALGOMA AND NIPISSING DISTRICTS.

By A. NIVEN,

Haliburton.

In the year 1896 the Department of Crown Lands decided upon running an exploration line to James Bay, and upon looking at the map of Ontario the boundary line between the Algoma and Nipissing Districts having been at that time run to a point 30 miles north of the C. P. R., seemed to be the most suitable line to run.

In the Revised Statutes of Ontario, 1897, this boundary line is described as follows:

"Commencing at the waters' edge of the Georgian Bay, near the most westerly mouth of French River, in the production southerly of the east limit of the Township of Humboldt; thence due north along a line formed by said produced limit, the east limit of said Township of Humboldt, the limit between timber berths numbered 59 and 67, 60 and 68, 61 and 69, and along the east limits of the Townships of Waters, Snider, and Rayside, and continuing due north to the northerly limit of the Province of Ontario.

The line here described would strike the south-westerly shore of James Bay some distance south-easterly of the mouth of Albany River.

The east boundary of the Township of Humboldt was run in 1892 by O.L.S. W. Galbraith, the length of the township being 11 miles, 18 chains, 67 links. Immediately north of Humboldt the line between timber berths 59 and 67, six miles, has not yet been run. The line between timber berths 60 and 68 and 61 and 69, by O.L.S. Wm. Bell, in 1873; the east boundary of Waters, by O.L.S. Burke, in 1883; the east boundary of Snider, by O.L.S. Isaac L. Bowman, in 1883; the east boundary of Rayside by O.L.S. Isaac L. Bowman, in 1884; the east boundary of Lumsden, by O.L.S. Laird, in 1887.

In 1888 O.L.S. Proudfoot ran the line from the north-east angle of the Township of Lumsden 18 miles north, and then ran a base line to the west.

In 1896 the writer was instructed to commence where O.L.S. Proudfoot left off, and continue the line north 100 miles. This

was done, the line being surveyed to a point 120 miles north astronomically from the north-east angle of Lumsden. Posts were planted at every mile and an iron post every three miles. The latter were of 1 1-4 in. gaspipe, 3 ft. long, pointed at the bottom, closed at the top and painted red, and the numbering was made continuous from Lumsden, the 120 mile post being in latitude 48 deg., 27 min., 54 sec. north.

In 1898 the writer was again instructed to carry the line on to the Moose River. This was also done, the line being surveyed to a point four miles beyond the Moose River, or to a point 300 miles north of the north-east angle of the Township of Lumsden, being about 312 miles north of the C. P. R.

The C. P. R., both main line and Sault Branch, crosses the boundary line in the Township of Snider and about four miles west of Sudbury. It will thus be seen that, with the exception of six miles immediately north of Humboldt, the line has been run a distance of about 353 miles from Georgian Bay. The longitude of the line, taking the Ontario and Quebec boundary line to the 79 deg. 31 min. west, is about 81 deg. 04 min. west. If produced south it would pass west of Owen Sound, west of Stratford, east of St. Mary's, east of London, east of St. Thomas, and strike Lake Erie about five miles east of Port Stanley.

The distance from the Township of Humboldt to Lake Erie is about 227 miles. If continued north it would probably strike James' Bay about 60 miles north of its present termination and about 45 miles south-easterly from the mouth of the Albany, making the total length of the line across Ontario about 640 miles.

The latitude of Moose Factory is given by Mr. Ogilvie as 51 deg., 14 min., 42 sec. north. The line, therefore, if continued to 312 miles would be about due west of Moose Factory, and distant therefrom about 20 miles.

Beginning at Proudfoot's base line, 30 miles north of the C. P. R., the line passes through a broken and hilly white and red pine country, filled with lakes to the 42nd mile, where it enters a comparatively level tract to about the 54th mile. The upper Wahnapitae River was crossed on the 41st mile. The height of land between the Georgian Bay waters and those of the Montreal River being crossed at the 50th mile. From the 54th to about the 100th mile the line again passes through a hilly and rocky country. At the 54th mile the line passes within a mile of the west branch of the Montreal River, running into it at the 68th mile, crossing it three times, and leaving it flowing easterly on the 71st mile. The height of land between the Hudson's Bay and St. Lawrence River waters is crossed on the 76th mile, Sinclair's exploration line of 1867 on the 86th mile. A noted land mark along this part of the line is Mount Sinclair, about seven miles east of the line and a little to

the south of Sinclair's line. It is said to be 1,500 ft. over the surrounding country. Numerous lakes were also met with between the 72nd and 95th miles. A little beyond the 100th mile we enter upon the good land, the level country that extends to James' Bay, and for the remaining 200 miles of the line the country is almost as smooth as the lawn in front of the Parliament buildings. The country may be said to be an inclined plane, falling to the north, but so gradually as to be imperceptible to the eye. For over 120 miles the line runs through a splendid tract of farming land, clay soil, often covered with black muck. Parts of it might be called swampy and parts of it muskeg, but taken altogether there are not many places in Ontario where a line can be run for the same distance through such an even uniformly good tract of land.

From about the 230th mile to the north end of the line the country is largely muskeg, but along the banks of streams, where the water can get away the land and timber is good.

The timber along the line from the 100th mile is chiefly spruce, tamarac being next in order, and poplar where the land is dry, with white birch, balsam, and balm of gilead. There is very little cedar in the country, generally only a fringe along the rivers. The spruce is from four to fifteen inches in diameter, and thick on the ground. Along the 170th to the 175th mile considerable scattering white spruce is to be found. There is no white or red pine beyond the 100th mile. I saw a few trees at Abitibi Lake on my way north, and some along the eastern boundary of Ontario, between Abitibi and Temiscamingue Lakes.

Lake Abitibi is said to be 850 feet above sea level.

The Abitibi River is generally from five to fifteen chains wide, but before entering Moose River half to three-quarters of a mile wide. The water is muddy, the current strong, and there are numerous rapids and falls. The line crosses it at the 170th mile, flowing north-west, and at the 288th mile flowing north-east. The latter crossing is about 15 miles from its junction with the Moose.

The Moose River was crossed on the 206th mile where it was a mile wide, current strong, water shallow and muddy, shoals and rocky in places, only navigable for canoes during first week in October. I went down from the Abitibi crossing of the line to Moose Factory, about 35 miles, in seven hours, but it took two days to come back.

On the 270th and 277th miles we ran across a bed of gypsum. The surface of this formation was very uneven and full of holes and caverns dangerous to walk over in places. We called it "the Holy Land." We camped there over a Sunday. Soap would not dissolve in the water, and it made abominable tea. Game was scarce along the line. A number of beaver were met with north of the Abitibi River; a few prairie chickens were seen, and not

many wild geese. It is said that they are not as plentiful as in former years, the stubble fields of the North-West having proved a great attraction to them.

The Hudson's Bay post of Moose Factory was established over 200 years ago, and has a population of about 500 during the summer months, when the Indians come in from their hunt.

The Moose Factory people know they are in Canada, and some of them believe they are in Ontario, but whether in Nipissing or Algoma is a matter of indifference to them, and I was told that the only magistrate there holds a commission for Thunder Bay. They get all their goods from England by the ship that comes in August and anchors in the Bay, ten miles from Moose Factory. Armour's pork and Manitoba flour, that has been twice across the Atlantic, sell there, the former at $27 per barrel and the latter at $10. Dry goods, boots, shoes, etc., can be had almost as cheaply as in Toronto. All kinds of vegetables and flowers were growing in the garden of the Bishop of Moosonee when I was there on the 7th of October. The tide water rises at Moose Factory from three to fourteen feet, according to the direction of the wind on James' Bay. During the spring flood the place is almost submerged. I left there on the 8th of October and travelled every day (two Sundays excepted) till the 27th, when we reached Abitibi Lake. We found the lake frozen and had to remain four days till the ice was strong enough to go upon, then between walking on ice and along shore and across points in the bush, and canoeing open stretches of water, we reached Lake Temiscamingue on the 24th of November and Toronto on the 28th, having had many hardships and narrow escapes. I regret to say that a halfbreed Indian from Lake Temiscamingue, who had been with me four years, was drowned at midnight on the 5th of November, in Lake Abitibi, the bark canoe in which he was with five others having gone down after colliding with a large piece of floating ice.

It was my intention to have connected my line with Moose Factory for the purpose of getting the longitude, but it was so late in the season when I reached Moose River with the line there was no time to do this. I checked the latitude as given by Mr. Ogilvie, only differing from him a few seconds.

DISCUSSION.

Mr. Sankey—I assure you it has given me a very great deal of pleasure to listen to the reading of this paper.

I have been asked since my return from that country to write a paper, but I did not think the information I had gathered during my very quick trip would warrant my doing so, especially when I knew Mr. Niven was making a survey and could tell us accurately what he had done.

The trip I took was for a totally different purpose, viz., to get a general knowledge of the country and to endeavor to find out if it were possible to reconcile the different reports that have already reached Ontario of the country through which Mr. Niven has travelled. The line Mr. Niven has run may be looked upon as the central longitude of the country that has been treated of in a great many reports. It was not until after I returned to Toronto that I was aware that so much had been printed and published about the very territory that Mr. Niven now tells us about; it is a strange country to most of us, although we are Ontario Land Surveyors. And with the exception of one or two reports I happened to get hold of I had very little information to guide me as to where I was going or how to get there. I have found out since there is one gentleman who has made that country a special study: I refer to Mr. Borron. He, I believe, was considered a mining engineer a great many years ago. But his principal duties up in that country were those of a stipendiary magistrate, and from away back in the seventies up to late in the eighties he has made trips along almost every river that runs into the basin of the Moose. I have succeeded in looking up some of the reports of that district; there is a very good collection of them in the library of the Parliament Buildings. Mr. Borron is now living in North Toronto, and his knowledge of that country is certainly most valuable to the Province. Much of it has been published in reports to the Government, and in printed pamphlets.

I started at the head of Lake Temiscamingue and went up Canoe River into Canoe Lake, a long lake of little importance as far as I could see. It is in the Province of Quebec, and the timber has been nearly all cut off about it. A large amount of good pine has been taken out of the country and gone down the Ottawa. Further on I came into Barrier Lake and then into Long Lake. We found nearly all the timber had been taken out about there. When you get up to the head of a north-east branch of Long Lake you turn into a small bay and then go up a small creek about 400 or 500 yards long. Then a small muddy lake appears about three-quarters of a mile long; this is the head waters of that point of the Ottawa basin. A portage of a mile and a half over a small gravel ridge brings you into a small lake, very muddy and marshy, with scarcely any current in it until you near the north end of it, and then you see the water running to the north. We soon got into

Island Lake, a lovely lake as far as scenery is concerned. I do not think I have seen its equal in Canada. The neighboring country is high, with hills 800 to 900 feet above the surrounding country. We then came into a lake called Upper Lake, and then into the east end of Lake Abitibi. This lake lies east and west with some deep bays north and south. I do not think the plans to-day convey any adequate idea of the lake. If you take a canoe and paddle, unless the wind is favorable, you will likely be delayed four or five days before you get across. I was pretty fortunate. I had the wind a little in my head going out in the morning, but towards the middle of the day the wind went down and we got over the wide crossing before night. That night the wind got up, and the following day we had to stay in camp until about three o'clock. We continued the next afternoon making a portage to get across. We went down the river, and then turning north-east we walked across the height of land where the water runs into Lake Temiscamingue by way of Blanche River. The timber is as Mr. Niven says, birch, spruce, poplar, more spruce than anything else in that country I should say. We came upon many tracts of brule, located in undulating country, and with some very simple form of drainage it would make a reasonably good agricultural country. There is very little rock showing. We went up Black River for 25 miles; a stream from three chains to a chain and a half wide. There are one or two very good water powers on the river, and some rapids, but it is not a river that could be looked upon as a highway. Still, it is not a hard river for a surveyor to travel on. Further on we crossed a spur of land into the basin of the Frederick House or Nighthawk Lake. Through this basin Mr. Niven's line ran until he made his first crossing of the Abitibi River. I then went along the Frederick House River, and struck a river between Nighthawk Lake and the Frederick House, and going down the river I connected with the Abitibi River where the maps show a rather sudden bend to the west. I understand in that particular place the Abitibi River itself is very rough with some bad rapids. From the junction of the Abitibi and Frederick House River, which might be some six or seven miles to the west of where Mr. Niven's line crossed, the river itself is a good one to travel on, and the country is undulating. After 26 miles on the river you come to a series of terrific rapids where the rocks come right up to the surface. You find more than rapids, really chutes, that no canoe could live in. You then reach the Canon Portage, where the river that has been reasonably wide, four or five chains in places, suddenly narrows into 70 or 80 feet, and the water goes through between two big walls of rock. I had the opportunity of going down along the whole course of this, and I saw some of it. At the head of the

portage, the highest part, you will be probably 200 feet above the water, and I am informed in some places the rock is almost sheer down to the water. The northerly end of that canon is one mass of rocks and troubled water, and the scene is magnificent. When you get down to the bottom of this you get into gravel banks, and the country is a great deal more hilly, the ground being from 180 to 200 feet above the river. You soon come to an outpost of the Hudson's Bay Co. called New Post. Further on you have fairly good travelling on the river, and then you come to the Otter's Portages. There are two. These resemble the canon I have already described. The portage is probably about three miles long, and when you get to the bottom of that you come again into the river, where it widens out. The water is shallow and the current swift, and we found it, if not dangerous, certainly difficult. The Indians I had with me did not know the river, but we got through without much trouble. One thing strikes me as peculiar—that Mr. Niven did not find any sudden step or jump off in the country to correspond with the canon and the Otter's Portage. On the river there is decidedly a big jump down, whereas from Mr. Niven's experience it appears to be a more gradual descent. His line, of course, is possibly 25 miles or more east of the Canon Portage, and I suppose he would have approached the Otter's Portage, 18 or 20 miles back.

I went on down to Moose Factory and spent several days there making some soundings and a rough exploratory survey of the mouth of the river—that is, out beyond Moose Island. Moose Island is the highest island in the river. It is near the middle, about a mile and a quarter of river to the south-east of it and possibly a mile and a half to the north-west of it. There is a whole cluster of islands and shallows. Almost from the mouth of the Abitibi River northward until you get out to the sea it is one continued series of shallows and islands down the middle of the river. The amount of material that the ice brings down every season is vast. When you get past Otter's Portage and strike the mist islands in the Abitibi River they are principally of a limestone formation, of a more or less friable rock and gravel, and the nose of every island is broken off. You can see ice marks on the trees 30 feet above the summer level of the water, where the bark has been knocked off the last spring. There was no drift wood along the shores of that river, and this naturally accounts for the very shallow mouth there is to the Moose. There is a narrow channel when you leave the mouth itself. The ship they have there, the "Mink," has to be lightened, and it takes all the men and women and all the cattle and horses they have there to haul that ship up. That is done once a year to get her out of the way of the ice. When you get out of the mouth of the river there are wide shallows that at low water are bare, and

covered at high water, but the main channel is not over three feet deep until you get far out.

However, a little dredging and a little improvement would make that channel, as a tidal port, perfectly feasible for vessels not drawing over 16 or 18 feet of water. Beyond that, I think the expense would be very great. The English ship arrived there when I was at the Moose. It was a good many miles out. I could see her sails and masts. I was sorry I could not wait to see some of the English sailors and smell tar once more, but I had been advised, the water was falling so fast, that if I wanted to get home without any trouble (this was about the 28th of August), I had better leave. I came home by way of the Missinabi River, that is the west river running into the Moose Basin. Some people say it is the Moose River. Others say it is the Mattagami. If you get any man living on the Missinabi he will call it the Moose. This river I found for 150 miles extremely shallow, worse in fact than the Abitibi although the water was not quite so rapid. No portages, but you have to wade up the river and haul your canoe up with a line. In some places there are deep pools and then long stretches of very shallow water until you arrive at the long portage. On all these rivers there is a long portage. You climb up a pretty nasty portage and go along the level, and do not seem to drop down nearly as much as you got up. Then you get into better paddling. We travelled five or six days further before we got into anything like nice travelling. At the same time I am quite satisfied that anyone coming back from Moose Factory should come back by this river, because, starting from the Moose, as Mr. Niven did, even if it is as late as the 8th of October, you would get the worst 150 miles over in the early time, and then as you came on you would not have the danger of the big lake Abitibi. You might have to wait until the ice set, and once it did set it would stay. When you get towards the end of the trip, to the head of Lake Missinabi, you are near a Hudson Bay post, where food can be obtained. There are also more Indians and other people along that river than along the Abitibi. The Missinabi is a long lake, but not very wide, and then when you reach the end of it you are at the C. P. R.

I think it would be advisable for our Association to get hold of different reports, maps and other information of this country and embody them in some way in our report. Care would be necessary, to see how far the information was reliable. Possibly we might get assistance from the Government or people interested. A combination of the various routes and means of going through this country and its resources would be a matter of very great interest to the public at large to-day, especially if we look upon James' Bay or the Hudson Bay as the sea port of Ontario. From a military

standpoint it is undoubtedly the proper entrance and safeguard of this Province, if any accident did happen to our communication between here and Montreal.

Mr. Niven—In reference to what Mr. Sankey remarked, that he expected that we would have found some jumping off place on the line, I may say that there was one place where we went down a little hill, and before we went down the hill, looking across the valley as far as we could see we thought we were going to get up upon another hill. But after running about 20 miles we could not find the hill, and we discovered it must have been a bluff of trees back on the high land I spoke of.

Mr. Sankey—In going up the Missinabi we also struck the bed of gypsum Mr. Niven speaks of, and one or two layers of lignite about the same latitude he mentioned. The deposit I saw along the river would extend possibly from a mile to three-quarters of a mile on both banks. Mr. Carter—There is a large deposit on the French River, just east of Mr. Niven's line, nearly as large as on the Missinabi River, which I have also seen.

Mr. Sankey's trip was more like mine than Mr. Niven's, as we both worked along the river.

The deposit of gypsum I mentioned on the French River is about 30 miles up from the mouth and it is nearly in a line with the deposit on the Missinabi River, and they are similar in quality.

I might mention that at New Post, on the Abitibi River (it is about 40 miles from its mouth), the water rises 29 feet and the width of the river increases about 100 yards then, so that there is a great volume of water going down every spring. One foot below the Factor's house there, marked at a log lying at the verandah, was the highest point the river had gone.

As to the limit of pine, Mr. Niven speaks of seeing some on the Abitibi Lakes. We found the same thing at Frederick House Lake, nearly due west. Mr. Sankey omitted to mention going through there, that there was a very long and tortuous creek, probbably 20 miles or more, where we had to get through logs. Mr. Niven's men went through and cut the logs, and we came through about four days after, and Mr. Sankey's men went through still later. It took more than a day extra on account of the logs. We gave that creek the name of Stick River.

Mr. Kivas Tully asked in regard to putting through a railway whether a good terminus could be found at the mouth of the Moose.

Mr. Sankey—The difficulty is this, with regard to the Moose River and all the branches of the Moose, in the spring of the year

all the ice that forms on these lower stretches of the river before any falls are reached, finds its way down to the Factory.

If you make a wharf or harbor at the mouth you are putting it where the ice may cut it out in the spring.

If a river can be found in the Bay where the fall is close to the sea it would be the place to put a wharf. When you get the ship in to the wharf it will be safe and the wharf will be safe, and the ice above the fall will rot and not do any damage coming down. You must look for the mouth of a river where a ship would not suffer. The north wind blows up a terrific sea, and a wind blowing for a few days down the bay will create such a sea that no ship could stand it. You must get into some shelter. Perhaps we may have to go to the east or south to the great Nottawa River, for the best harbor.

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THE PAYNE RIVER DRAINAGE WORK.

By T. H. WIGGINS,

Cornwall.

On the 20th day of April, 1896, the Council of Finch appointed me to make an examination, prepare plans, etc., and to report upon the drainage of certain lands in their township, in accordance with a petition signed by six interested parties. These lands were along the banks of the Payne River and its tributary, Beaver Creek.

Shortly after receiving the appointment I examined the lands of the petitioners to estimate the work necessary to relieve them from being overflowed and to make them useful for agricultural purposes; and found that the probable cost for deepening, widening, straightening, etc., two miles of the Payne River and three-quarters of a mile of Beaver Creek would be over $10,000. The proposed improvements of the lower mile of the Payne River I estimated to cost $6,132.50.

The drainage basin contained an area of 24,000 acres, of which only 336 acres were low land directly benefited by the work. The drainage area of 20,400 acres comprised 14,081 acres in the Township of Roxborough, 1,563 in the Township of Finch, and 4,765 in Osnabruck Township. This low land was of very little use in its present condition, being principally swamp and beaver meadow. I asked myself would an engineer be justified in making an assessment to drain lands for an amount almost sufficient to purchase the area to be benefited. This question, however, was settled in my mind when the adjoining Township of Roxborough appointed me to make a survey, etc., of the Payne River, in their township, in accordance with a petition of the land-owners along the river extending to nearly the source of the drainage basin.

The estimated cost of the extension in Roxborough was over $14,000, thus making the total cost of Payne River and Beaver Creek drainage work over $24,000, for a work extending about eleven miles.

Very much speculation was indulged in during the survey and while the scheme was being laid before the people, by those who were interested and who would be assessed for the cost. Some of the remarks made were interesting and original. "It will swamp the county," said one. I answered that our aim was the very reverse of swamping the county. "I'm going to give my farm

away and move out of Ontario, where they have no Reformers to make bad drainage laws," said a Tory. "What nature has done cannot be bettered," was a statement from an old farmer who had lived for 60 years in a little log shanty surrounded by stumps with a frog pond at his door. "What are you here for, measuring my high land, which requires no drain?" "Have I got to pay for digging a canal through McMillan's land?" "Are you going to dig a canal through that hill and leave the river for a frog pond to drown my cattle and make us pay for it?" etc., etc. The drying of the adjacent wells was another cause of complaint.

The farmers, however, in the drainage basin, generally speaking, were intelligent and knew the benefits to be derived from surface drainage, but tile drainage is a matter almost unknown in this section except as a medium for draining cellars.

The assessments for benefit varied from $2 to $10 per acre, and for outlet liability from 5 cents to $1 per acre.

The by-laws for raising money and carrying on the work were provisionally adopted in March and April, 1898, and the work was let to contractor J. T. Gagnon in July of the same year for about $2,500 less than the estimated cost.

None of the persons assessed carried appeals against the assessment further than the Court of Revision, composed of members of the Council, and I think the reason why there were so few appeals and why they were so readily dropped was that the lands assessed were all carefully measured and the drainage area exactly defined.

During the months of August, September, October, and November the contractor excavated in round numbers 109,000 yards of earth and 700 yards of loose and solid rock, without the use of steam machinery. The contractor's prices were: 20, 14, and 15 cents per cubic yard for earth excavation and 45 cents and $1 for loose and solid rock excavation, $6.50 a yard for masonry in bridge abutments (of which there were about 100 yards), $75 and $100 per ton for iron used for bridges, and $14 per thousand feet, including the material and construction, for cedar for culverts.

The disposition of the material from the cuttings is a very important feature in drainage work, and in order to have the contractor do this work well my assistant or I were on the ground very often.

The work is not yet completed, but we hope to have it done before the 1st of July, 1899.

At the lower end of the work a cut of 200 feet long and 6 feet deep was made, which lessened the distance 1,500 feet. This cut necessitated the construction of a 40 ft. span bridge. My first idea was to construct the bridge of two 30-inch steel web girders, but as a through bridge was required in order to get a sufficient

water way, I reported in favor of a truss bridge. Two small 20-ft. span bridges were constructed, with iron beams (25 lbs. per lineal foot). The iron work was furnished by the Dominion Bridge Co., of Lachine.

In making calculations for the capacity of the drain, I assumed a rainfall of 2 1-2 inches per day, and that 1 inch per day would reach the stream. I measured the volume of the stream at different points during heavy rains and freshets.

The lower portion of the work was through a narrow valley or river channel with banks about 25 ft. above the bed of the river and 50 to 75 ft. wide. The cutting here was 25 ft. wide at the bottom and the side slope 1 1-2 horizontal to 1 vertical (the slope of the sides throughout). Trees and shrubs grew abundantly on both sides of the valley, making it very picturesque, but when about 300 ugly-looking large boulders were uncovered I feel quite satisfied that it did not look very picturesque to the contractor, who felt that the work was draining his pockets as well as the land of the farmers.

At one point in this valley, in the centre of the excavation once the site of an old mill-dam a little island had been formed by debris brought down by the river. This old dam had been built over 80 years ago, yet the timber in the lower portion of it was in a remarkably good state of preservation, and showed mortises nearly as fresh-looking as when cut. Some fine specimens of beaver cutting were also found at this point.

Last fall the efficiency of the drain in freshets was an agreeable surprise to the owners of the once low lands along the work, and the expenditure of $24,000, I feel assured, will enhance the value of lands in the County of Stormont $85,000.

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FIELD TILE DRAINS.

W. F. VAN BUSKIRK,
Stratford.

The primary object of making field tile drains is for the purpose of removing the drainage or hydrostatic water of the soil. The upper surface of this standing water, technically known as the water table, varies in height in different soils and with the quantity of water that may percolate through the soil by gravitation.

The design of drains necessary to lower the water table will, therefore, vary with the soil and with the quantity of water to be removed. It will be evident also that the design should be such that the drains will not cost more than is warranted by the nature of the work they will be required to perform.

The construction of tile drains in all cases should be such as to secure the maximum of efficiency, since the laws that govern the flow of water are unchangeable.

Carelessness and ignorance of proper methods of doing work are expensive in the end, and the amount supposed to be saved by employing cheap labor, with interest at an exhorbitant rate, becomes a first charge upon the profits of the investment.

A glance at the papers on farm drainage contained in the Reports of the Superintendent of Farmers' Institutes, indicates a want of knowledge of this important branch of farm management. It is, no doubt, true that the neglect of drainage is in part due to the frequent failures to make it pay, but it must be also that the many advantages of thorough draining of all soils are not known.

Our client, the farmer, does not yet realize that the drainage lore of but a few years ago is as much out of date as the flail and the cradle.

The study of thorough drainage as a branch of agriculture has kept pace with other branches of the science, and the uniform certainty of results which obtains in all other industries can be arrived at only when the practice of the art is based on principles in harmony with the laws that govern the operations of nature.

It is obviously impossible in a paper of this kind to discuss the physiology of plants, and their relation to the soil and its moisture. A statement of a few of the known facts may, however, be of value in directing attention to the subject.

The ordinary farm plants require for their development a proper supply of food and moisture and a favorable temperature. These requirements can be controlled to a more or less extent by efficient field tile drains.

The food and moisture are, to a large extent, obtained from the soil, and as the surface of the water table is the limit for healthy root growth, it is evident that the drains should be laid at a depth sufficient to afford room for the economical development of the plant.

It has been thoroughly established that the roots of most of the ordinary farm plants will, under favorable circumstances, penetrate the soil to a depth of upwards of four feet; and it may be taken for granted that a four foot depth of soil is the minimum for profitable production.

The roots, root fibrils, and root hairs of healthy plants penetrate every available space between the particles of soil, and extract from the soil and the air contained in its interstices the oxygen and mineral constituents of plant food.

Vigorous growth requires, therefore, a finely pulverized soil, free from drainage water, in order that the spreading delicate mass of roots may be in contact with the moist particles of earth and the air.

This condition of soil is also favorable to the action of bacteria of nitrification, by the agency of which the nitrogen of organic substances, the ammonia of the soil and manures, and the atmospheric nitrogen is made available for plant food.

It may be mentioned that the popular theory, that the free nitrogen of the atmosphere is appropriated directly by plants, is entirely erroneous, and practical inferences from it are misleading.

The bacteria of nitrification are aerobic, that is, requiring air for their development. They also require heat, and cannot live in a cold, undrained soil.

Heavy soils, in a saturated state, are injured by working, or by the treading of cattle, as they are thus rendered more compact, and when the water is removed by evaporation they become hard and tough and do not readily absorb water again. Thoroughly drained soils, on the other hand, are not thus injured, but are rendered capable of holding more water than before by about 20 per cent., as their hygroscopic and capillary properties are increased. The decrease in evaporation through drawing off water by drains saves an enormous amount of heat, and the increase in the hygroscopic property actually increases the heat of the soil. Thorough drainage, therefore, not only increases the depth or mass of soil from which the roots gather food and moisture, but also increases both the food, moisture, and heat in all parts of the

soil. The plants in cultivation are thus provided with strength to resist all unfavorable seasons. Warmth is provided to resist frost, and moisture is stored for use in dry periods.

The requirements of a good drain or system of drains are:

1st. That it will keep the water table low enough to prevent damage to roots or soil.

2nd. That it will work at all times without deterioration or loss of efficiency.

ARRANGEMENT OF DRAINS.

The natural surface drainage system of the tract to be drained should be studied and made the course of the main drains. Lateral drains leading to the main drains should in all cases be laid directly down the slopes in the lines of greatest descent. Laterals thus laid share the work equally, and water does not escape from them in its passage. A drain laid across the line of slope takes in water from the upper side only.

In case of a very flat valley receiving water from slopes on either side, it is sometimes advisable to lay two main drains in place of one of large size. Such drains can be laid near the foot of the slopes, and may have the gradient increased by running the head ends into the rising ground. The flat valley can then be drained by small independent drains.

FALL.

The fall or gradient of drains should be as uniform as it is possible to make it, and if at all possible of increasing descent to the outfall, in order to avoid the deposit of silt. Wherever it is found necessary to make a change from a very rapid gradient to a rather flat one, it is advisable to put in a silt basin to prevent deposits and an overflow pipe to prevent a washout.

Nearly all authorities on drainage recommend a gradient of not less than three inches in 100 feet; but in many localities such a requirement is out of the question. Drains can be made to work well with less than one inch in 100 feet, but it is needless to say, that such an inclination requires extreme care in grading and pipe-laying.

All tile drains should be laid to exact grade, otherwise the depressions in grade will become partly filled with silt, and the effective waterway thereby decreased. The theoretical grade line should be transferred from the stakes by means of boning rods, and in case of large-sized pipes on a flat grade, a straight edge should be used, bringing the whole invert of all pipes to exact grade.

DISTANCE BETWEEN DRAINS.

For thorough drainage, with drains laid to a depth of four feet, the distance between drains should be: For clay soil, 20 to 30 feet; for light soil, 35 to 40 feet; for gravelly soils, 40 feet and upwards.

Where drains are laid at a less depth than four feet, as is sometimes the case in draining roads and foundations for sidewalks, etc., the drains should be placed closer together than as above suggested.

PIPES AND LAYING.

Tile pipes should be thoroughly hard burned, not warped or out of shape in an way whatever; one bad pipe may destroy a long length of drain. Where drains are laid under roads and foundations this is of great importance. All pipes used should be round, and when laid in the trench each separate pipe should be turned until the top fits closely against the end of the previously laid pipe, making a close joint at the top.

Where branch drains enter, junction pieces should be used, if procurable, if not, it is well to place a length of larger sized pipe over the joint.

FILLING IN THE TRENCH.

After laying the pipes, a layer of a few inches of fine earth or clay should be filled in carefully over and around the pipes, care being taken that all open joints are stopped with small pieces of sod. Fine earth should then be filled in lightly to a depth of one foot; over this, ordinary soil should be filled in, and the surface layers thoroughly well tamped and consolidated.

The object of covering the pipes with clay or fine earth is to prevent water flowing in streams into the joints between the pipes, and the object of tamping is to prevent water flowing through fissures in the trench directly from the surface of the ground to the tile.

Water enters a well laid and properly working drain through the bottom and sides of the joints between pipes, after flowing along the top of the permanent water-table to the drain.

Drains laid as above described will not, for a time, take in and carry away water as quickly as those covered with gravel, stone, or other loose material; but they will, after a time, thoroughly aerate all parts of the surrounding soil, since the gradual vertical flow of water from the surface of the ground to the water-table, and thence along the water table to the drain, will tend to make the whole mass of soil porous.

Drains of this character do not easily become stopped, and may be considered a permanent improvement.

DISCUSSION.

Mr. Bowman—With regard to the depth of tile drains, it is hard to convince farmers that it is necessary to put them as deep as four feet. They think it is throwing away money to put a drain down more than two feet. In the older parts of the Province tile drainage is being carried out more and more every year, and if one were to visit a farm he had known twenty years ago you would probably find the surface of it very much changed. Where there were small creeks, pot holes, swamps, by means of tile drains those have all disappeared, and the farmers are wakening up to the fact that they can reclaim a great deal of what they used to consider was necessarily waste land.

Capt. Gamble—How deep do they put the tile drains generally ?

Mr. Van Buskirk—Farmers put in tile drains themselves, and they put them in just so deep that the plow will not disturb them. To put in tile drains properly requires levelling, and in the West the draining will be finished before many years, except repairs, and that does not require a great deal of work. It is very important that the surveyors should take an interest in this question as to proper tile draining and teach the farmers, going round to farmers institutes and telling them the facts of the case.

My former partner, Mr. Davis, read a paper last year on the use of large tile drains in covering ditches. We have put in large tile drains, 12 to 14 inch, ordinary field tile. As to what has been said of water getting through the body of the tile itself, I do not believe that at all. When I was first working at it I got a good many different kinds of tiles, and I put in a cement bottom in the drain and filled the tiles with water, and if it took as long to get in as it did to get out of those tiles you would not get any water off the farm.

You make the top of the tile perfectly tight by turning the pipe around in your hands until it fits exactly at the top, then cover that joint with clay so that the water will not come in from the top of the tile—so the water comes in from the sides. It does not bring sediment into the pipe if it comes that way.

Mr. Bowman—It is a popular misconception about drain tiles, as to the water getting through them. A good many farmers think the water gets in through the pores of the clay. An eminent authority on draining, the late Col. Warring, gave his opinion that if fields were tiled with glass pipe they would operate just as successfully as with ordinary field tiles. The water all gets in at the joints. The water rises from below really.

Mr. Morris—Did you never have the pipe covered with pea-straw or something to prevent the sediment from working down through, so as to fill the pipe. I do not mean the smaller branches, but the main drain, that is to your outlet.

Mr. Van Buskirk—You cannot make them perfectly tight; it is well to put a small piece of sod over. I would do away with the pea straw idea, because that leads to porous covering all the way up and the water will get directly from the surface running in to the tile, and will bring the sediment into the drain.

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1—BRIEF HISTORY OF PERCH DRAIN DREDGING WORK, TOWNSHIP OF SARNIA.

J. H. JONES.

That the chief object for which this paper has been written may, perhaps, be better understood, the writer desires, by way of introduction, to give a brief account of the natural condition of the lands in the Townships of Sarnia, Moore, Enniskillen, and Plympton, the waters from which flowed into the Perch Creek (or "Riviere aux Perches," as it was called in the early days), and also a short history of the means adopted from time to time for their drainage.

Originally the Perch was a slow, sluggish stream, and the land on either side of it for a considerable distance was marshy and swampy throughout the greater part of its whole course. About four miles from the mouth of the stream it entered a small body of water known as the Wawanosh Lake, about one thousand acres in area, and about eighteen inches deep at summer level.

The lake was soft and "gruelly" at the bottom, and surrounded on all sides by a dangerous quagmire. It was a perfect duck-hunters' paradise in the early days, there being swarms of ducks of every variety the year round, except the winter months, besides geese and swans galore in the fall and spring. There were also large cranberry marshes in the neighborhood of the lake.

One of my most vivid recollections of the old Perch is of a lovely Sunday morning in the spring of the early forties. The mouth of the Perch was literally alive with "suckers," and the writer was told not to spear them because it was Sunday. Temptation too great—caught in the act of spearing the first sucker—marched home a prisoner—made study Watt's hymns on Sabbath desecration and disobedience to parents for the rest of the day—blew a gale of wind from the north by Monday morning—no suckers. Following week "grub" short in consequence.

The total area drained to the Perch and Wawanosh is as follows: Township of Sarnia, 18,500 acres; Township of Moore, 5,000 acres; Township of Enniskillen, 1,400 acres; Township of Plympton, 1,100 acres; making a total of 26,000 acres.

The first move that was made in the way of draining Lake Wawanosh was done in the year 1837 by a person named Cull, who cut a small drain, for some reason of his own, on lot 24, Front

Concession (see Diagram), from the bank of Lake Huron straight south, through the thick rose bushes, perhaps 80 or 90 rods, or sufficiently far to let the water through from one of the marshes connecting with Lake Wawanosh.

Subsequently this drain enlarged itself very materially and wore back some fifty rods further south into the marsh. The next step that was taken was by the Municipal Council of the Township of Sarnia, who instructed Senator Vidal, P. L. S., to report as to the best method of draining Lake Wawanosh, and he recommended the construction of a drain nine feet wide at the bottom, and in its present location, to connect with the Cull drain on lot 24, the surface level of Lake Wawanosh at that time being about eleven feet above Lake Huron.

This report was adopted, notwithstanding that some thought that more satisfactory results would be obtained by making a cut straight north on lot 36, through the sand hills into Lake Huron. Shortly after the adoption of Senator Vidal's report, the Council commenced to put it into effect; but was strongly opposed by some of the parties interested, and to avoid further trouble the municipality got a special Act passed in 1857, authorizing them to drain Lake Wawanosh and also empowering them, among other things, to sell the reclaimed lands. The work was then proceeded with, and this drain, comparatively speaking, dried Lake Wawanosh, and the Sarnia Council subdivided the lake bed and sold the land.

Nine years afterwards they continued the drain further south, and also improved the Perch Creek bed up to side road 12 and 13. Nothing more was done until the year 1871, when the Ontario Government undertook the drainage of the Township upon the requisition of the municipality. Among other works, the Government materially deepened and enlarged the Wawanosh and Perch drains, and extended the work to the town line of Moore. This work was a great improvement on the past, and very beneficial, but in course of time it got very much out of repair and entirely inadequate for the purpose for which it was designed, principally in consequence of the very largely increased drainage works constructed by the neighboring townships, and by the Township of Sarnia itself, making use of the Perch drain as an outlet.

Law suits for damages were threatened, and indeed commenced against the Township of Sarnia by owners of lands all along the Perch drain, and in consequence the Municipal Council were forced to take action, notwithstanding the strong opposition of the owners of the upper lands, who, of course, could not see why they should be asked to contribute.

The Sarnia Township Council, therefore, instructed the writer to examine the whole Perch drain and report. At an early period

in this investigation it was quite manifest that ordinary repairs would be entirely insufficient to accomplish what was needed. It seemed clear, to begin with, that if anything at all was done to the old drain, one of the most essential improvements would be a very decided enlargement of the drain through the deep cut from the margin of Lake Wawanosh to the "Cull," a distance of a mile and a quarter, of sufficient capacity to give free discharge for the water, so that there would be no "backing up" and flooding the old Wawanosh bed, which is only eight feet above the present level of Lake Huron.

Surveys were made in every direction that seemed by examination to be at all practicable, with a view to a new outlet that would also form a "cut-off" for the low lands, but formidable obstacles were met with on each route besides the cost of constructing at least one expensive bridge across the Grand Trunk Railway.

For these reasons it was finally decided to report in favor of the old course, in the belief that better results would be obtained at a very much less expenditure than any other route, taking all the present circumstances into consideration. Plans, specifications, and report were prepared, therefore, recommending the deepening and widening of the old drain, commencing at the centre of lot 10, in the 3rd concession, thence to the outlet. From the head of the new work to Waddell's Creek, the new cut to be 20 feet wide in the bottom, about 7 feet deep, with a fall of 7 feet per mile to the railway, and 3 1-2 feet per mile the rest of the way. From Waddell's Creek to the north side of the lake, 28 feet in the bottom, about 9 feet deep, with a fall of 2 feet 3 inches per mile. From Wawanosh to the outlet, 30 feet bottom, about 13 feet deep, and 1 1-2 feet fall per mile.

This proposition was submitted to the Municipal Council, and was adopted by them, and after a good deal of "kicking" by some of the upper townships the by-law was finally passed, and the work advertised.

THE DREDGING.

The first attempt to let the work proved to be unsuccessful. Some six or seven tenders were received, but the person to whom the contract was awarded, upon second thoughts, refused to proceed with the work, and paid forfeit. Then a good deal of controversy arose among the knowing ones, who said that it was very doubtful, indeed, whether the work could be performed with a dredge, so as to at all satisfy the requirements of the specifications. At this time even Mr. Lister, the then Township Solicitor, who throughout advised the municipality with his usual ability and good judgment, seemed to lose faith, and said to the writer, "If

this method of doing the work fails, you are assuming a grave responsibility." The reply made was, "This work must be done with a dredge, or not at all." It was also strongly urged that the estimated cost, namely six cents per cubic yard, was altogether too low, without taking into consideration the formidable obstructions occasioned by the two Grand Trunk bridges, and the heavy work near the outlet. The estimate was made strictly in accordance with what appeared to be in the township's interest, and experience proved it to be sufficient.

After considerable delay, a bargain was at last made with Pollard, Goff & Co. to construct a new dredge at the upper end of the work, and to complete the whole contract of 8 3-4 miles, including the construction of the dredge, at an average cost of five dollars and a half per rod.

In a couple of months the dredge was completed and ready to commence March 30th, 1896. The dimensions of the dredge were as follows: Length, 72 feet; width, 22 feet; 34 feet over all; 4 1-2 feet deep. Two floats at bow, each 25 feet by 8 feet; 3 anchors, 12 inches by 14 inches; crane, 50 feet in length; dipper arm, 33 feet; reach of dipper arm and crane, 48 feet; dipper, 3 feet 4 1-2 inches by 2 feet 9 1-2 inches by 3 feet 9 inches; boiler, 11 feet by 42 inches; nominal h.p., 45; cylinders, 8 inches by 12 inches.

When running she required two crews of six men each all told for twenty four hours, and consumed 4 1-2 cords of soft wood in that time. Two dipper loads would be landed on the dump each minute when she was doing her best, and each move, which took three or four minutes to make, advanced her about eight feet, with ease and dispatch with the crane. Green stumps of all sizes were shattered with dynamite and also quickly taken out of the way with the dipper and a strong chain.

From the point of commencement to the G. W. D. of the G. T. R., a distance of 470 rods, the cutting was through ordinary stiff clay. The average progress made on this section was 18 rods per 24 hours removing about 85 cubic yards per rod. No dams were necessary across the stream, the water supply from above being amply sufficient to carry on the work.

When the railway was reached, the bridge had to be passed, which is 28 feet span, and 12 feet from the under side of the girder to the water. In order to do this, the dredge had to be "stripped," which kept the contractors busy for nine days before work was resumed again on the north side of the bridge.

From the railway down to the north side of Lake Wawanosh, the surface was irregular and the cutting through long stretches of alternate black muck and hard clay. No particular difficulty, however, was encountered, with the exception of a portion about three-quarters of a mile in length, just below the mouth of the

Waddell Creek, where very soft, deep, black muck was met with and much trouble and delay occasioned by there being no holding ground for the anchors, and also the weight of the earth banks would crowd in the sides, notwithstanding that a good layer of brush had been laid on the sides before the earth was put out. When the dredge was backed up to take out what had squeezed in, the dipper would work the whole thing up into the consistency of porridge, that could not be dredged. The best job was made of this part of the work that could be done under the circumstances, and eventually the water from above washed the cutting clear.

For a mile above the London road, the banks were high, and the clay very hard, indeed, but fair progress was made, notwithstanding this. The 40 foot iron bridge at the London Road was removed by being raised with jackscrews, and pushed to one side on skids.

North of the London road, and across Lake Wawanosh, the surface was more uniform, and nothing was met with that deserves special observation, except, perhaps, that the bottom across the old lake bed was a genuine "hard-pan."

Notwithstanding this, and the before-mentioned obstructions, an average of 16 rods per 24 hours, and cutting about 90 cubic yards per rod, was made, including all unavoidable delay, from the railway to the north side of Wawanosh, a distance of 1,850 rods.

We met with a "calamity" on the section north of the London Road, in consequence of an open half-box of dynamite being left on the dump, some distance behind the dredge. A yearling calf came along and ate several sticks of the powder—the calf "departed."

After the London Road was crossed, July 22nd, dams were made across the stream at certain distances ahead of the dredge, in order to save all the water possible to complete the work with.

The section from Wawanosh to the outlet was where the most difficulty was encountered. The drain here, as constructed by the Government, was 22 feet wide in the bottom, and about 10 feet deep when new. The present drain is 30 feet wide at the bottom and 2 1-2 feet deeper than the Government work. This very considerable increase in size cut into the old earth banks, and made the vertical depth from the top of the old earth bank to the bottom of the new drain about 20 feet. This cutting was chiefly through a wet, sandy soil, that caved easily, especially as it was overlying a muddy clay bottom that was altogether too yielding to hold the dredge up stiff on her anchors; and, consequently, every time the crane swung with a load, she would settle down on that side, making it exceedingly difficult to put a dipper load to the full extent of the reach of the dipper arm. One side of the work was taken out at "a set," and as far as possible before anything was done

to the other side, and in order to overcome the settling of the anchors, before described, a bench was made in the bank, and the corner of the bow boat was pushed in as far as possible, and made to rest upon it.

This very materially assisted the anchors to hold the dredge firmly up against the swing of the crane and loaded bucket, and in this way much better progress was made. The caving behind the dredge caused the most anxiety, as it was feared all the time that a considerable length of the new made earth bank would suddenly slip in and completely prevent the dredge from "backing up." Nothing serious, however, occurred in this way, although several bad slides did take place, but not before the dredge was put out of harm's way. All through the worst of this section, the cutting was very heavy, quite twice as much as would have been necessary under ordinary circumstances, on account of the soft, greasy nature of the soil required to be moved, the cut for a long distance being 80 to 90 feet wide at the top and 180 feet from the extreme of one earth bank to that of the other.

The average progress made through this part of the work was 8 1-3 rods every 24 hours, and the whole contract was finished by the 10th of November, 1896, having taken 192 days to complete, and an average made of 14 rods per day, including all delays, except the passage of the Grand Trunk Railway bridge in the 4th concession.

When the end was reached, it was with feelings of relief and satisfaction that we looked back upon what had been accomplished, because it was then quite clear that if any mistake had been made in the first instance as to the power or capacity of the machine necessary for the performance of the work, failure would have been inevitable. For example, if the contract had been commenced with a dredge similar to one that was being used on another drain close at hand, it would have been utterly useless when the deep cutting was arrived at, and it would have then been too late to rectify the error.

Before the contract was finally let, much was said about the probable impossibility of making the side slopes of the drain conform to the requirements of the specifications; but, as a fact, no trouble at all was experienced in this respect. The bottom width was increased slightly, and the side slopes were cut nearly 1 to 1, if not quite, and in one year after the work was finished the drain was in better condition, and more fully up to the mark, than if it had been done with a plough and scraper. Care was taken to make the cut rounding in the centre, and rather below what was required, and in order that the chief force of the current might be kept in the middle of the drain in the future. The earth banks, too, were well put back.

LAKE HURON
G. T. R. MAIN LINE
HIGH SAND HILLS
LAKE FRONT LOTS
GORE
LONDON ROAD
TOWN LINE
W. DIVISION
DRAIN
CREEK
MOORE
SARNIA
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VIII VI
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Before closing this narrative of the Perch dredging contract, it is only just to say that the contractors performed their work vigorously, and most satisfactorily throughout, doing more than strictly required, when occasion made it necessary, without hesitation or cavil.

Up to the present date, the new work has given every satisfaction, notwithstanding that there has been one or two freshets since completion.

The total available sectional area of the cut at the outlet is 480 square feet, or 1.84 feet for each one hundred acres of area, and the flow when nearly full is about 2 3-4 to 3 miles per hour. The total area of 26,000 acres is now pretty thoroughly surface drained, the upper third having a fall of about seven feet per mile, the middle third about three feet per mile, and the outlet third about 1 3-4 feet per mile.

[*This Association is not responsible as a body for any opinions expressed in its Papers by Members.*]

PERMANENT WAY.

W. E. McMULLEN,
St. John, N.B.

That the tendency of civilization has always been towards permanency of structure is well evidenced by the existing engineering works of ancient Egypt, Greece, and Rome, and in the many mighty works of the present time. Railway building, while one of the most important branches of modern engineering, has, however, been beset with such peculiar conditions that to obtain anything more than a moderately durable construction has been found a somewhat difficult problem on account of the numerous variable and unknown quantities which enter into its solution. It will be acknowledged, though, that a permanent way, if it be possible, is the objective goal of all intelligent railway builders, both for its safety to travellers, goods, and equipment, and its economy of tractive power and cost of maintenance. Heretofore there probably have been very good reasons for a more or less temporary construction such as (a) the item of first cost until the success of the enterprise has been assured and until the earnings of the road give encouragement to expenditure upon a more durable construction; (b) economy of construction, necessitating a roadbed more or less temporary in the first place as a basis for permanent work; (c) the rapid evolution of rolling stock from the very small engines and coaches of fifty or sixty years ago to the hundred-ton moguls and heavy sleepers of the present day. Had some of our railway enterprises attempted permanent construction at their inception they would have lived but little past their birth, and had some others followed the plan of more gradual permanence of structure and roadbed their shareholders might have obtained at least a little interest on the capital invested in stock. Then, again, an absolutely smooth and durable road is not at first a necessity, but it is in most cases very necessary that a road commence to earn some money before entering upon an engineering construction more expensive than will in safety carry their trains. Besides this, permanent construction has generally been found more economical when carried on from a road already constructed, by means of which supplies can be transported, filling performed most easily, and masonry built without impeding traffic and with an economical force of men, since then the time for the completion

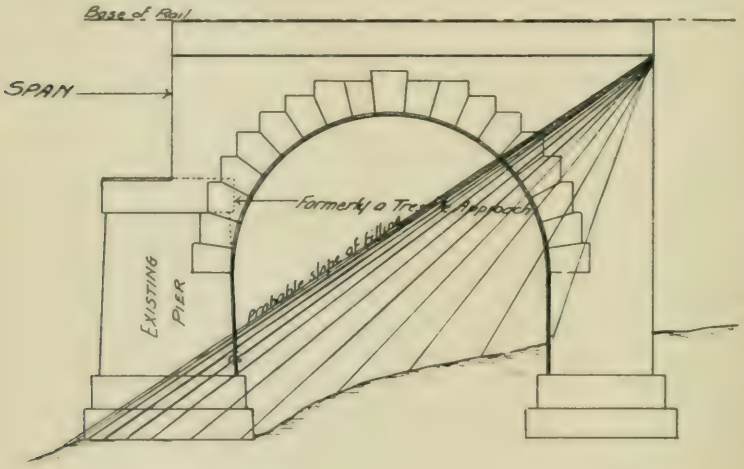
of the work is not now of prime importance, and, moreover, money may be expended upon the work as it becomes necessary.

The reasons, however, which held good for present construction no longer are sufficient for the retention of a system which requires a prodigal expenditure of labor and material, provided it can be substituted for one which gives a larger place to durability and economy.

In considering permanent way, undoubtedly the first care will be to fill all unnecessary openings in the line, such as trestles crossing the ravines of small creeks, the wooden approaches to steel bridges, open culverts which can be replaced with closed water-ways and pit cattle-guards. The first of these can usually be provided for with masonry culverts or iron pipes. Where the embankment will be high, but with little water passing under the track, cast-iron pipes have been found to work very well, and are much less expensive than arch culverts if the water-way required be a small one, say less than the area of a five-foot arch culvert. The lower side of the intake end should be placed well below the bed of the stream and have an apron of boulders or timbers at the outlet to prevent back-scouring, especially if there is much of a fall in the pipe. The pipe also should be laid on a firm foundation, so that an even grade may be maintained when the filling comes upon it. It is usual to make the joints with Portland cement, but since there is very rarely much internal pressure, they do not require the same care in laying that water service pipes would, and in fact rejected pressure pipes may often be used and found satisfactory for the purpose at a considerable saving on the cost of A1 pipe. Sometimes the pipe is built into masonry at the ends, giving the work a more finished appearance, protecting the ends from being broken, and preventing the filling from falling in front of the pipe. Of cattle guards little need be said, for whether they be pit or surface they are a necessary evil. The pit guards are gradually going out of use, as they are dangerous to trains should a beast become lodged in one, since in case of derailment before coming to the pit it would be liable to pile up the cars when they came to it. Pit guards are also receptacles for rubbish and snow, are expensive to maintain, and generally give the track a bad surface when the frost gets into the roadbed. Surface guards are free from most of the objectionable features of pit guards. They are not expensive to maintain, do not necessitate an opening in the road, and are not a menace to derailed trains. The principal objection to the surface guard is that it does not turn stock (or perhaps it will be better to qualify that by saying that cattle often seem to delight in walking over or jumping the surface guard). There is little question, however, that the surface guard with its imperfections is to be preferred to the pit, and, as considerable inventive

energy is constantly being spent upon cattle-guards, something more effective in this way may be expected.

Before leaving the subject of the elimination of openings in the line, mention might be made of a method in use upon the Canadian Pacific Railway in connection with steel bridges upon stone piers with trestle approaches, where the approaches have to be filled and some provision made for the slope at its junction with the pier, when, as is generally the case, the pier is without wings and is not designed to act as a retaining wall. The accompanying sketch illustrates the method followed, viz., that of springing an arch of sufficient span from the existing pier and filling over it so that the toe of the slope will extend to the stream side of the pier or as far



as the nature of the location will permit. The advantages of this principle over the use of wing, T or U walls, are in elegance of design and economy of masonry.

But having provided all openings in the road with permanent or durable structures, there now remains still the greater part of the line supported upon a sub-foundation varying with the temperature and weather, upon wooden ties which require frequent renewal, necessitating a continual breaking up of the roadbed and with a running surface which while good in itself is so dependent upon its foundation that it is also frequently requiring renewal at considerable cost and inconvenience to traffic. The first thing necessary for a permanent track is a road-bed which shall be dry at all times, at least above the frost line. So long as a track foun-

dation can be reached by rain and snow water a perfect surface will never be obtained. The method adopted thus far in railroad construction has been to provide a porous or approximately porous covering for the surface at sub-grade, such as gravel, broken stone, cinders, burnt clay, crushed slag, etc., and to construct side ditches to carry off the water. Where there is a good thickness of this covering or ballast, and where the ground at sub-grade is so sloped as to assist in carrying the water to the ditches and the ditches themselves of sufficient depth and cross-section to take the water a fairly good foundation for the track may be expected, but in cold and wet climates there will be even with a well-ballasted road a certain amount of heaving. This may not be very noticeabble where the material at sub-grade is of a uniform quality, for then the heave will also be uniform, but where there are bridges upon masonry foundations and alternate cuts and fills the difference in the heave at these places will be quite appreciable, causing rough track.

Even were a frost-proof roadbed obtained there would still be a perishable track support to provide for before permanency of way has been attained. For a number of years the almost universal system of track support in America and Great Britain has been the wooden cross sleeper, and although in many respects a most primitive and unsatisfactory method of supporting a rail, for want of a cheaper first cost substitute, or one which could be more expeditiously put into the road it has received general adoption. Ordinarily ties are from 8 ft. to 9 ft. in length, 6 to 8 inches thick, and 6 to 10 inches on the face, the specification varying with different roads and localities, that of the Atlantic Division C. P. R. being 8 ft. long, 6 in. thick, and 6 in. face. Some ties are sawn, some hewn, some put in with the bark on (which, by the way, is very bad practice), and some peeled. There is much variety also in the class of wood. In the northern roads cedar, spruce, tamarac, hemlock, white pine, white oak, and in the southern roads white oak, yellow pine, chestnut, cypress, etc., are all brought into service for track ties, and are serviceable anywhere from five to fifteen years, depending largely on the class of timber used, the amount and weight of the traffic, whether upon curve or tangent, the condition of the roadbed, the climate, and whether they have been treated with a preservative process or not. There are usually from 2,640 to 3,000 to the mile, and the cost before putting under the track will vary from 15 cents to 50 cents each, according to the locality, the class of timber used, etc. Sooner or later, though, these ties will have to come out. After a few years of service in a well ballasted road the tie will be well packed and firm in position, but the weather has so rotted the tie that it will not hold a track spike, or perhaps on account of shimming in the winter the tie is spike-killed or perhaps cut very

badly by the outside of the base flange, and so the road-bed is torn up, a new tie put in and packed, and the old one thrown to the fire. So has the process been and so it will be until something better is provided. To avoid some of the objectionable features of the wooden tie, tie-plates and steel ties have been introduced, the former quite extensively in the United States and the latter principally in Europe and India, but to a very limited extent on this continent. The tie-plate is usually a piece of steel plate from 4 to 6 inches in width, 8 or 9 inches long, and from three-sixteenths to thirteen-sixteenths inches thick (there are so many different patterns of tie-plates that it is difficult to describe them in general terms). Flanges are on the underside which press into the fibres of the tie and keep it securely in its place. It has been of excellent service on southern roads in preventing the cutting of soft ties, thus ececting considerable economy in tie renewals and cost of maintenance labor. Where there is frost enough, however, to heave the track, necessitating shims, its use is not general, since the shims cannot satisfactorily be used on top of the plate. The metal tie is usually a pressed steel channel, with closed ends, like an inverted trough, the object of its use being permanency of road-bed and economy in tie renewals. When properly coated with tar it is very durable, it does not cut, and when well settled into the road-bed has very materially reduced the cost of maintenance. It is highly improbable, though, that it will ever be used in cold countries, with the present style of road-bed, even should timber become much more expensive than it is, on account of the difficulty in using shims with it, for a metal tie would heave quite as badly as a wooden one, and as a rail support has many of the objections which pertain to the wooden tie. But granted that there is a stable road-bed upon which staunch and durable cross-ties are placed, there is still a jointed track to take care of. How to keep up the joint and prevent rails from flattening at the ends has been the source of much thought, many devices, and the expenditure of considerable money, and the problem is to-day far from being satisfactorily solved. There have been two general classes of joints, supported and suspended. Each has its advocates, but there has not yet been constructed a joint either supported or suspended, lying within the limits of economy in first cost and application, which is as rigid or nearly so as the rail itself. Those who favor supported joints claim that a tie placed immediately under the contiguous ends of the rails is the best means of holding up the joint, while those who believe in the suspended joint assert that one tie is quite insufficient to maintain a joint properly, and so put in two ties, one on either side of the joint, as close together as they can be to pack well, and depend upon the joint being upheld by the strength of the fibres of the projecting rail ends, assisted by the angle-plate or splice-bar. As a com-

promise between the suspended and supported joint a three-tie joint has been introduced and used to a considerable extent upon the roads of this continent, the endeavor being to include in it the advantages of both suspended and supported joints by using angle-bars from 30 to 44 inches in length instead of the ordinary length of 24 to 30 inches and having under them a joint tie and two shoulder ties.

To produce the results expected from this joint, the shoulder and joint ties must be well kept up and be on the same level, or the effect will be a long suspended joint, a weak supported one, or perhaps a bent angle-bar if one of the shoulder ties is low. Another class of joint, not so universally in use as the ordinary angle-plate connection, but which has proved to be very effective, is the bridge joint. These have been fashioned in a number of ways, but the principle has been to suspend the joints by an iron plate placed underneath the ends of the rails, turned up over the flanges, and bolted through the web. With some bridge joints extra stiffness is obtained by trussing them on the underside.

The object of all this is to effect as nearly as possible a continuous rail. A joint in the track is always objectionable, for at that point the track is always weaker than at any other, causing the ties under it to receive more directly the wheel impact and making it very difficult to keep the joint ties on a level with the others in the track. Being weaker there is more deflection in the track, so that as the wheels come within a foot or so of the joint in fast running they are apt to jump and deal the next rail a blow a little beyond the end, flattening the rails at the ends and so making a rough riding track. When once a joint is badly down with flattened or vertically bent rails it can never be made good again until the rails are cut or new ones are put in. It is well known by trackmen that as far as maintenance is concerned the joint requires more attention than all the rest of the track.

In speaking generally of the standard track of to-day, it may be described as laid upon a variable foundation, supported in a manner which is more or less safe and far from economical, and connected in a way both expensive and in a degree ineffective. The question, then, is, "What principle will be adopted in the design of permanent road-bed when the time comes, as it surely will, for the change?" It was partly with the object of suggesting thought in this direction that this brief summary of track parts with some of their weak points was brought before the Association. Two designs described in a recent number of Engineering News are worthy of mention. The first, by Mr. J. W. Schaub, recommends commencing at sub-grade with a 12-inch layer of Telford stone or broken boulders as large as a man can lift; after this a six-inch layer of broken stone concrete, strengthened by steel wires

running through it. Above this is a six-inch top layer of gravel concrete crowned up between the rails to the level of their top. Through this crown pass one inch diameter tie rods for the purpose of connecting the parallel rails. These tie rods are spaced eighteen inches centre to centre, and the threads or nuts and rods are machine cut.

The rails are to weigh one hundred pounds per yard, and are to be continuous in lengths of about three hundred feet. They are to be rolled in lengths of sixty feet and spliced with angle-bars and turned bolts in the field. Where expansion and contraction are to be provided for, the rail ends should be scarfed and one end provided with slotted holes. At the expansion points the concrete road-bed should be discontinuous, so as to allow the concrete and track rails to expand and contract with perfect freedom.

The rails are to rest directly on the concrete, and are held in place only by the tie-rods spaced eighteen inches apart. All adjustments as to guage are made by the nuts on the ends of the tie-rods.

The drainage below sub-grade is to be effected by side ditches lined with porous tile and underlaid with a tile pipe drain. He estimates the cost of the road-bed to be $14,000 per mile, exclusive of rails, as against $6,000 per mile for the present form of track, which would with money at 4 per cent. mean an extra charge of $320 per mile per year against capital account, but this he estimates would be off-setted at least by a saving of $390, the cost of one man's labor on maintenance for a year, and by $180 more in the charge for renewals of ties, making an annual saving of $250 per mile, exclusive of anything which might be saved by less wear and tear on rolling stock and reduction in fuel through less tractive power being required. (Note.—This estimate of $6,000 per mile would scarcely apply to Canadian gravel-ballasted roads, which, exclusive of the steel, might be estimated to cost a third of that sum. The larger estimate is based upon broken stone, $1 per yard, and ties, 60 cents, and is inclusive of tie-plate).

A suggested improvement upon this design so far as economy of material was concerned, was to commence at sub-grade by rolling the road-bed perfectly hard and firm, and upon this to spread a two-inch layer of sand or gravel, on which concrete blocks 10 ft. long, 15 inches deep, 10 inches at top and 26 inches at base were to be carefully laid as longitudinal supports for the rails. Elevation for curves would be made by extra thickness in this sand layer, except in the case of very sharp curves, when it would be made in the road-bed at sub-grade. The rails would be held down to the blocks by clips held in place by 1-inch bolts at 40-inch centres, moulded into the concrete blocks, and steel guage bars would maintain the alignment of the track. Between the parallel

concrete supports earth would be filled and covered with a layer of asphalt to turn the water. The concrete blocks would be held in position laterally by the guage bars, designed to sustain compression and vertically by a two-inch iron dowel moulded into the end of one block and fitted into an iron-cased hole in the other. Spaces three and a half inches wide would be left under the rail at each guage bar to carry the surface water from between the rails. The estimated cost of this road-bed was $6,000 per mile. Examining these propositions first from a financial standpoint: in the first case upon the assumption that the present form of road-bed is $2,000 per mile and cost of renewals, $110 and money worth three and one-half per cent. instead of the figures given, even with this expensive design there would be an apparent saving of $80 per mile per year, and in the second proposition, estimating in the same manner, a saving of $360.

There will no doubt be criticisms of the designs and many difficulties foreseen before any radical change could be made in construction of road-beds, yet the very fact that saving could probably be effected makes it a matter worthy of the consideration of engineers.

Among the objections to the principle of the designs above mentioned which might be offered are, as far as the first proposition is concerned, the large initial cost; against the second, the liability of there being vertical movement between the ten-foot longitudinal blocks of concrete, even with the assistance of dowels. The difficulty of setting heavy concrete blocks at an exact super-elevation for curves and maintaining them there under heavy traffic, the lack of facility with which broken bolts and tie-rods could be quickly replaced in case of derailment and against both designs by the hammering of drivers upon the rail, when the base, which has little resilence, would act as an anvil, by the great expense which would be incurred by single track roads in taking care of their traffic while the road was being torn up.

So great is this last objection that such a work could scarcely be recommended to a busy single track line, especially where there are narrow cuttings and high dumps. This objection, of course, would not be of so great moment to double track lines. It should always be borne in mind, too, that if repairs were required to the concrete or should there be, by any mischance a settlement or upheaval in the road-bed the cost of setting it right would be far greater than with the present form of track.

The advantages, however, make the difficulties worth the thought required for their overcoming, namely, reduction in the cost of maintenance, greater safety to rolling stock, termination of increasing weight of rail, no trouble with splice bars, and low

joints, a better riding road, and greater security against creeping track.

It is not expected that Canada will immediately see the introduction of a permanent roadway, for ties and labor still are cheap and experiments dear. Our double track mileage is yet small and trunk lines few, but no doubt our neighbors to the south will before very long require a substitute for the wooden tie which already is with them an expensive article and what that substitute will be and what excellence it shall possess will be the result of the "brawn of the brain" of the cosmopolitan engineer.

[*This Association is not responsible as a body for the opinions expressed in its Papers by Authors.*]

A SUGGESTED AMENDMENT TO THE DITCHES AND WATERCOURSES ACT.

GEORGE SMITH,
Woodville.

The ordinary observer of the agricultural development of this Province cannot fail to notice the urgent necessity for a drainage law, simple and prompt in application, which will enable the ordinary farmer to obtain an outlet for the tile drainage work, which is rapidly becoming an absolute necessity to him if he is going to keep abreast of the times in his calling.

The average thinker is under the impression that we have such a law in the Ditches and Watercourses Act, but, to the engineer, experienced in the working of this Act, it becomes apparent that it is a failure, if so intended, and it is clearly evident to him that its astute framers were persons familiar with the suspicious and quarrelsome side of human nature, and also well aware that it is from this human weakness that lawyers reap their harvest, and he (the engineer), although sworn to be disinterested and impartial, soon finds out that the honor of being a "Township Engineer" is much more likely to bring discredit on his profession and ill-will to himself than professional advancement.

In the writer's fifteen years' experience of the working of this Act he has many times heard the interested farmers declare in favor of the principle of arbitration, in settling the inevitable disputes arising therefrom, and he has, as many times, been forced to the conclusion that they were right in this idea.

In his idea the present Act might do very well up to sec. 13, if the position of township engineer was abolished and that official relieved of the honorable position of being a mud-target for lawyers as well as the members of the Council by whom he is appointed, which is about what he gets if he does not succeed in pleasing every person interested. If the parties fail to agree at their meeting or within five days thereafter, the promoters and those who are opposed to the work might have a board of three arbitrators appointed in the usual way from among any of the number of County Commissioners within ten miles of the drain, and this arbitration, so appointed, to constitute a Board of Works to construct the drain or otherwise dispose of it, as they saw fit. They should employ any O.L.S. to prepare a plan of the swamp, shewing drain location

and areas, profile and sections of drain, etc., with reports and full information, in the same manner as is usually done in making an award, and with this to guide them they should make an award which should be without appeal, provided that due notices were served upon all parties affected. In the writer's opinion, no person other than an O.L.S. is competent to undertake such a survey, as, in his experience, it almost always happens, in making an award, that it is desirable to have part of the drain, at least, constructed along a boundary line, which boundary line has generally to be located, and another still more desirable feature in such a law, to our profession, would be, that we would be relieved from the humiliation of being appointed and controlled by the ordinary Township Council, which honorable body being composed, as it almost always is, of much more conceit than intelligence, is not at all improved in this respect by the adoption of the recent County Councils Act, and to please such a body the O.L.S. is often obliged to imperil the honor and integrity of that profession which he is pledged to uphold.

During the past season the writer made an award between nine interested parties, one of whom (a woman) appealed against it, and although the document is dated July 25th, 1898, nothing has since been heard of it, and the eight others were thus obliged to lose all the advantage of an unusually favorable season for the construction of a badly needed drain, and so far as he has been able to learn from the lawyers the appellant's solicitor is expected to call the appeal before the Judge when it pleases him to do so, as the word "forthwith" in the fifth line of s. s. 3 of sec. 22 does not mean anything in particular, and his sole object in making the foregoing suggestion is that it may be discussed and improved upon, and eventually result in some better legislation than we have yet been blessed with, and our profession, as well as the public which we are honestly striving to serve, be relieved from this huge humbug.

APPENDIX.

BIOGRAPHICAL SKETCH OF ROBERT BALDWIN SULLIVAN.

SURVEYOR GENERAL FOR UPPER CANADA 1838-1840.

Robert Baldwin Sullivan, the subject of this memoir, attained not only to the distinguished position of Surveyor-General, but was also a judge in the Province of Upper Canada, and an eminent member of the Legislative Assembly. He was born of Irish parents who lived at Bandon, near Cork, Ireland. His father, Daniel Sullivan, during the troubles of 1798, was engaged in trade, making money, if not a fortune, supplying the troops with necessaries during that remarkable period of Irish history.

Daniel Sullivan had been intended for the church, and while at Trinity College, Dublin, he was a proficient in classical literature, and carried off the Greek prize. However, when the time for his ordination arrived, as he could not conscientiously subscribe to the Thirty-nine Articles, he gave up theology and went into business. He was married to Miss Baldwin, sister of Dr. Baldwin, whose name is so familiar to all Canadians, and they had four sons, Daniel, Robert, Henry and Augustus. Robert the second son was born at Bandon, on the 24th May, in the year 1802. He was from childhood a bright, intelligent boy, quick to learn, and what was better, able to retain in a remarkable degree, any knowledge he acquired. His early education was obtained at the principal private school of Bandon, supplemented by his father, who instructed him in the classics. In 1819, when Robert was but seventeen years old, Dr. Baldwin induced his father to emigrate, and make Canada his future home. Dr. Baldwin was then living in York, and had acquired a reputation in this new town in Canada, both as a doctor of medicine and a lawyer. Dr. Baldwin was also at this time a member of the Legislature of the Province. Mr. Sullivan, in leaving Ireland to make a home in Canada, was not going among strangers, his brother-in-law, the doctor, having reached a high position in the new land.

When Daniel Sullivan arrived in Toronto, acting on the advice of friends, he embarked in trade, and opened a general store just east of where St. James's Church now stands, on King Street. The boys of the family assisted their father in his shop; but this occupation did not long suit Robert. Dr. Baldwin, his uncle, was engaged both in medical pursuits and in law. Robert Sullivan, in choosing for himself a profession, preferred the law. The education he had received in Ireland now served him in good stead. Applying himself to his books he prepared himself to become a law student, and was, as student, entered in the books of the Law Society in Michaelmas Term, 4 George IV., 1823. On passing his examination he entered the office of his uncle, Dr. Baldwin, where he passed his five years of probation, and was called to the Bar in Michaelmas Term, 9 George IV., 1828.

During his studies in Dr. Baldwin's office he was able to devote a portion of his time to another pursuit. Just then the library of Parliament was in want of a librarian. His knowledge of books and Dr. Baldwin's influence secured for him this office.

As soon as Robert Sullivan was called to the Bar, he determined to strike out for himself. Doctor Rolph, who had lived at Vittoria, in the County of Norfolk, had made up his mind to remove from that place. Mr. Sullivan thought that this offered an opening for him to enter upon the practice of his profession at Vittoria; true it was remote from the capital, but this did not signify to him, he was determined to exercise his talents at the beginning, in some place, where if success were to be his, it would be based on his own merits; he never was a man to shine with borrowed light. He had been in Vittoria but a few years when he was called upon by Dr. Morrison to act as his council before the Legislative Assembly in his contest with Mr. (afterwards Chief Justice Sir) John Beverley Robinson, for the Parliamentary seat of York. This was a spirited contest, not only out of but in Parliament, and resulted in Mr. Robinson retaining his seat.

Mr. Sullivan acquitted himself so well before the Legislature in this trial of strength, that friends at once took him by the hand, and insisted on his coming to York where he would receive their patronage and support. This was in the year 1830, when he was but twenty-nine years of age. Mr. Sullivan could not but accept this flattering offer, and about this time moved from Vittoria to the capital, where he became junior partner in the office of his uncle.

When he had made his home in York he soon rose into popular favor, as is evidenced by the fact that he had not been a resident of the place more than five years when he was elected Mayor of Toronto over William Lyon Mackenzie, who was his opponent for the mayoralty in 1835. Mr. Mackenzie was Mayor of Toronto the

year previous, but was not able to hold the position the second year against Mr. Sullivan, who had been elected member of the Council for St. David's Ward.

Mr. Sullivan, being elected mayor, applied himself vigorously in advancing the interests of old York, now Toronto city and the capital of the Province, in the matter of drainage and other works of necessary improvement.

The City Council has kept in remembrance the second mayor by a portrait of Mr. Sullivan, which hangs on the walls of the Mayor's office at the City Hall.

Mr. Sullivan's term of office as mayor having expired, he was not long in being sought after for further and higher employment. The early months of the year 1836 find Sir Francis Bond Head the Lieutenant-Governor of the Province.

Shortly afterwards the Governor's council, finding that His Excellency was making appointments on his own responsibility without consulting them, retired in a body.

Under these circumstances the Governor knowing, or having heard of the distinguished ability of Robert Sullivan, sent for him, and sought his advice.

In the general election of 1836 a House hostile to the existing state of things had been elected. Parliament was called to meet in November of that year. The Governor was certainly in a dilemma, and needed advice. Mr. Sullivan was a non-partizan man; he was just the kind of adviser the Governor required in such a crisis. He was selected as adviser more on account of his talents than his politics. He was not alone in entering the Council, others, viz., the Honorable William Allan, Captain (afterwards Admiral) Augustus Baldwin, uncle of Robert Baldwin, and John Elmsley, were called to the Council with Mr. Sullivan. Mr. Draper (afterwards Chief Justice Draper) was soon after added.

Mr. Sullivan has sometimes been called a Tory, or Conservative, sometimes a Radical; the fact is, he was Mr. Sullivan, and that was all. He was not a party man in the strict sense. His partyism, if he had any, consisted in his desire to advance the interest of the Province under the aegis of Great Britain—he was a Reformer, but not a Radical.

The Legislative Assembly, in the session of 1836, as I have said, was hostile to the Governor. It was equally true that the Governor was hostile to the Assembly. In the view of the Assembly, an Executive Council without Robert Baldwin or Marshall S. Bidwell, ought not to possess the confidence of the country. The Assembly, holding this view, passed a resolution of want of confidence in the new Councillors, and Mr. Sullivan had to go with the rest.

On 4th March, 1837 Sir Francis Bond Head thought proper to dissolve the House of Assembly. A most exciting election took

place, which resulted in the return of a House opposed to the introduction of Responsible Government.

When the rebellion broke out in December, 1837, Mr. Sullivan buckled on his armour in defence of the Province. Both by precept and example he shows his abhorrence of rebellion. With Dr. Baldwin and Robert Baldwin he felt reform was necessary in the government of the country, but did not believe that armed revolt was the proper remedy for existing grievances.

In the autumn of 1837 Sir Francis Bond Head resigned his office of Lieutenant-Governor, but held office till the close of the session, which took place on the 6th March, 1838.

Mr. Sullivan had the confidence of the Governor during his whole administration.

Sir George Arthur succeeded Sir Francis Head as Lieutenant-Governor on 23rd March, 1838, and Mr. Sullivan was his most trusted Councillor. Sir George Arthur's Lieutenant-Governorship was, however, overshadowed by the advent to the Province of Lord Durham as Governor-General, which took place in the autumn of 1839, and, on his return to England, by Mr. Poulett Thompson (afterwards Lord Sydenham), who was sent out specially to build up a union of the provinces, founded on the report which Lord Durham made to the Imperial Government. The lesser light of the Lieutenant-Governorship was dimmed by the greater light of the Governor-General.

Lord Durham was in Toronto for one day, in July, 1838, and received an ovation from the citizens.

When Lord Sydenham came to Toronto in November, 1839, he took upon himself the management of affairs with the sole view of promoting the union. He took up his residence at Beverley House, and from thence used all the means at his command to influence Parliament, which met in the early part of December, 1839. He found the Legislative Council composed of honorable members not likely to yield to his wishes, unless he could have the support of some trusted man of ability to advocate his views.

One of the first to coincide with the Governor-General's views was Mr. Hamilton H. Killaly, who was soon after selected to form a Board of Public Works, thus overthrowing the despotism that prevailed in that Department. At this time Lord Sydenham became impressed, not only with the oratorical powers of Mr. Sullivan, but with his aptitude to advance the work in hand. Mr. Sullivan was his principal adviser in all the negotiations entered into, and his spokesman when he wished his views conveyed through other channels than his own. In the Legislative Council he advocated the union with all the eloquence at his command. He dealt with all the arguments advanced against the union in a masterly manner. He assured the House that Her Majesty was

determined to maintain the connection between the colonies and the mother country. This was the foundation on which he raised a noble superstructure.

In June, 1838, Mr. Sullivan occupied the position of Surveyor General, and continued in this office until September, 1840

In February, 1839, Mr. Sullivan was appointed a Legislative Councillor.

The Act of Union between the Provinces of Upper and Lower Canada passed in 1840, was announced by proclamation to come into effect on 10th February, 1841. The first Council after the Act of Union had been proclaimed, was formed on 13th February, 1841, and Mr. Sullivan was a member of that Council. Mr. Sullivan continued to hold office after the formation of the first Baldwin-Lafontaine Administration, which took place on September 16th, 1842. From the period of the union, up to the time of his resignation in 1843, he was the senior member of the Council and leader of the Government in the Legislative Council; while in the Assembly, although Mr. Harrison (the Honorable S. B. Harrison) conducted the business, Mr. Draper was in effect the leader. During the period from the union in 1841 to the resignation of the Baldwin-Lafontaine Administration, both Lord Sydenham and Sir Charles Bagot were in their turn Governors of the United Provinces. Lord Sydenham met with an untimely death, the result of an accident, in September, 1841. He was succeeded by Sir Charles Bagot, who survived his appointment only about nineteen months, and died at Kingston on the 19th May, 1843. Sir Charles Metcalfe succeeded Sir Charles Bagot, and held office until November, 1845, when he was obliged to resign his position on account of ill-health.

The Baldwin-Lafontaine Administration, of which Mr. Sullivan was a member, had the entire confidence of Sir Charles Bagot. When, however, Sir Charles Metcalfe came out as Governor, he was not so ready to yield to the advice of his Ministers as Sir Charles Bagot had been.

A rupture soon occurred between Sir Charles Metcalfe and the Baldwin-Lafontaine Cabinet. The Governor demanded to have the patronage of the Crown in appointments to office, while the Council held that the patronage was theirs to exercise so long as they had a parliamentary majority. On this question the Ministry resigned. Mr. Sullivan was no sooner out of office than he took up the pen to defend the Administration and its principles.

Sir Charles Metcalfe had a doughty champion in Doctor Egerton Ryerson.

Mr. Sullivan wrote a series of letters in "The Examiner" newspaper, under the "nom de plume" of "Legion." Never before in Canada had more scathing letters on a political subject been written by any man. These letters are full of interest as to the principles of Responsible Government, enforced with logic and syllogism which had never been surpassed. Both the Reverend Doctor Ryerson and Mr. Sullivan are in their graves, and it will not be well, therefore, to exhume the controversy which was held by these two combatants, in which sarcasm as well as reasoning so much abounded.

When Mr. Sullivan left the Government he resumed the practice of the law in Toronto. He and Mr. Shuter Smith, of Port Hope, entered into partnership, and carried on their practice under the firm name of Sullivan & Smith, in Wellington street, Toronto.

Mr. Sullivan took great interest in all public matters. In 1847 he delivered a most excellent address in the Mechanics' Music Hall, Toronto, on the subject of "Emigration and Colonization." His address was productive of much good in stimulating emigration, and showing the capabilities and resources of Canada, as a field for the husbandmen of England and Ireland. Little was then known of the country to the west of Lake Superior. Mr. Sullivan related what he had heard from Mr. Angus Bethune and Mr. Ermatinger, then very lately from that country. Mr. Sullivan stated that the Saskatchewan River ran from west to east fifteen hundred miles without obstruction! A truth we all know now, but which was then thought to be almost fabulous. Mr. Sullivan's whole address showed the unbounded confidence he had in the possibilities of the future of Canada, so remarkably realized since his death.

Mr. Sullivan was not only a lecturer, but also a lover of poetry, and often indulged his fancy in versification.

He was a most agreeable conversationalist, and was a scholar in every sense of the word, well acquainted with the prose and poetical writings of the past centuries as well as the present. He could read and translate French fluently, and frequently found this useful in a Government composed of both English and French members.

Mr. Sullivan was twice married: first to a daughter of Captain Matthews, who was a distinguished officer of artillery, and was with Sir John Moore in his retreat to Corunna. By his first marriage Mr. Sullivan had but one child, a daughter, who died in her infancy. His second wife was a daughter of Colonel DeLaitre, by whom he had several children.

Judge Falconbridge, of the Queen's Bench Division of the High Court of Justice, married one of his daughters, the late Chief Justice Thomas Moss also married one of his daughters and Judge Charles Moss, another.

Surveyor-General Sullivan, will be remembered by all who knew him with affection and regard. He died at Toronto on 14th of April, 1853, at the early age of 51 years.

An obituary notice of him truly recorded that he was "Distinguished as a lawyer, statesman and orator; that he won admiration and esteem by his splendid talents and the eminent services which he rendered to his adopted country in the Legislature and the Executive, during an eventful period of Canadian history, while in private he gained the affections of his associates and friends by the gentleness of his disposition and the generosity of his heart."

PAPERS USED AT THE FEBRUARY SESSION OF THE BOARD OF EXAMINERS, 1899.

PRELIMINARY EXAMINATION.

Subjects Nos. 1 and 2.

PENMANSHIP, GRAMMAR AND ORTHOGRAPHY.

1. Write from dictation . . . . .

2. Give the plural form or forms of staff, die, pea, canto, cargo penny 8, brother, basis, index, miasma.

3. Give the principal parts of rend, lay, rise, lie, bid, wring, dare (to venture), chide, fly, awake.

4. Correct or justify the following:

"Toronto is the largest of any city in Ontario."
"Try and meet me to-morrow."
"I will buy a fifty feet chain."
"It is seven days since I have arrived."
"Less than fifty soldiers were killed."
"One of the best of his men were wounded."
"Seeing you and I coming he hid himself."
"Some of the best of we candidates may fail."
"From one bank of the river to another he swam easily."
"He was killed with a trenchant blow."

"Near yonder copse where once the garden smiled,
And still where many a garden flower grows wild,
There, where a few torn shrubs the place disclose,
The village preacher's modest mansion rose.
A man he was to all the country dear,
And passing rich with forty pounds a year."

(a) Transpose the above extract.
(b) Parse the words underlined, giving the relation of each.

Subject No. 3.

ARITHMETIC.

1. Reduce $\frac{11}{3}$ of $1\frac{999}{1000}$ to a simple fraction.

2. Reduce the following fractions to equivalent ones with the least common denominator $\frac{7}{15}$ of $\frac{4}{5}$, $11\frac{1}{15}$, $\frac{1}{2}$ of $\frac{18}{7}$ of $3\frac{8}{9}$.

3. Divide $1\frac{1}{3}$ of $\frac{84}{100}$ by $1\frac{1}{5}$ of $1\frac{2}{5}$.

4. Find the square roots of 687241, 151321, 45369, 87025.

5. Extract the cube roots of 13261, 13269, 830585, 830597, and give the remainder in each case.

6. It is required to build a sidewalk a quarter of a mile in length, 8 ft. wide and 2 inches thick, supported by 3 continuous lines of scantling 4 inches square; what will the lumber cost at $17 per thousand feet?

7. Fill in the blanks in the following Tax Bill. Amount of Assessment $900:

County rate, $3\frac{8}{10}$ mills on the dollar -	$.....
Model School rate, $1\frac{1}{4}$ mills on the dollar -	.....
Railway Debenture rate, $2\frac{6}{10}$ mills on the dollar	.....
Township rate, $1\frac{4}{10}$ mills on the dollar -	.....
General School rate, $5\frac{1}{10}$ mills on the dollar -	.....
High School rate, $1\frac{3}{4}$ mills on the dollar -	.....
Total Taxes - - -	$.....

8. Find the export duty on a stick of timber 20 ft. long, 3 ft. wide, and 2 ft. thick at $2 per 1,000 ft., board measure.

9. My salary is $1,200. If I pay 30 per cent. of it for board, 20 per cent. of the remainder for rent, 15 per cent. of the residue for clothes, $71.20 for books, and loan 40 per cent. of the remainder, what per cent. of my salary is unexpended?

10. A hare is 75 of her own leaps ahead of a hound, and she takes 5 leaps for every 3 the hound takes, but he covers as much in 1 leap as she does in 2. How many leaps will the hound take before he catches the hare?

Subject No. 4.

LOGARITHMS AND ALGEBRA.

1. Simplify:

$$2a - (2b - d) - \{a - b - (2c - 2d)\}$$

$$6a - \{4b - \{4a - (6a - 4b)\}\}$$

$$2a - \left[5a - \{2a - (2a - 5a - a)\}\right]$$

2. $$\frac{x+3}{2} - \frac{x-2}{3} + \frac{3x-5}{12} + \frac{1}{4}$$

$$\frac{4x+17}{x+3} + \frac{3x-10}{x+3} = 7$$

3. (*a*) Divide 75 into 2 parts so that 3 times the greater may exceed 7 times the less by 15.

(*b*) A watch gains as much as a clock loses, and 1799 hours by clock = 1801 hours by watch. How much does watch gain and clock lose per hour?

4. Define a Logarithm. What is the characteristic?

How are log. sines, tans, etc., calculated as used in the tables?

Find the log. sin of 35° 24′ 36″.

Find the angle whose log. tan = 10.9205559.

Find the logs. of .00764, 76432.

5. Show that every quadratic equation can be put in the form $x^2 + px + q = 0$.

Solve:

$$3x^2 - 4x = 39$$

$$x^2 - 3 = \frac{x - 3}{6}$$

$$\frac{x - 1}{x - 3} + 2x = 12$$

Subject No. 5.

EUCLID.

Book I., Prop. 16. If one side of a triangle be produced, the exterior angle is greater than either of the interior opposite angles.

Book I., Prop. 29. If a straight line fall upon two parallel straight lines, it makes the alternate angles equal to one another, and the exterior angle equal to the interior and opposite upon the same side, and also the two interior angles upon the same side together equal to two right angles.

Book I., Prop. 32, Cor. 1. All the interior angles of any rectilineal figure, together with four right angles, are together equal to twice as many right angles as the figure has sides.

Trisect a right angle.

If in the sides of a square, at equal distances from the four angles, four points be taken, one in each side, the figure formed by joining them will also be a square.

Book II., Prop. 111. If a straight line be divided into any two parts, the rectangle contained by the whole and one of the parts is equal to the rectangle contained by the two parts, together with the square of the aforesaid part.

Book II., Prop. 11. To divide a given straight line into two parts, so that the rectangle contained by the whole and one of the parts shall be equal to the square of the other part.

Book III., Prop. 1, Cor. If in a circle one straight line bisect another at right angles, the centre of the circle is in the line which bisects the other.

Book III., Prop. 22. The opposite angles of any quadrilateral figure inscribed in a circle are together equal to two right angles.

Book III., Prop. 36. If from any point without a circle two straight lines be drawn, one of which cuts the circle and the other touches it, the rectangle, contained by the whole line which cuts the circle and the part of it without the circle, shall be equal to the square of the line which touches it.

Book IV., Prop. 6. To inscribe a square in a given circle.

Book IV., Prop. 10. To describe an isosceles triangle, having each of the angles at the base double of the third angle.

Upon a given straight line describe a regular octagon.

Subject No. 6.

PLANE TRIGONOMETRY AND RULES FOR SPHERICAL.

1. Prove that $\sin (90^\circ + A) = \cos A$
and that $\cos (90^\circ + A) = -\sin A$.

2. Find all the angles between 0 and 900° which satisfy the relation $\tan \theta = 1$.

3. Find the number of degrees in the angle subtended at the centre of a circle whose radius is 10 feet by an arc 9 inches long.

4. If D be the number of degrees contained in an angle, C the number of grades in the same angle, prove that $D = C - \frac{1}{10} C$, and $C = D + \frac{1}{9} D$.

5. What form the sides and angles of a spherical triangle?

6. Show that the three angles of a spherical triangle are together greater than two right angles and less than six right angles.

7. Give from Napier's Analogies the other form for
$\tan \frac{1}{2} (A + B)$ and $\tan \frac{1}{2} (A - B)$
$\tan \frac{1}{2} (a + b$ and $\tan \frac{1}{2} (a - b$.

Subject No. 7.

MENSURATION.

1. The base of the Great Pyramid of Egypt is a square of 764 ft. in each side; find the number of acres of ground covered by it.

2. The sides of a triangular field are 32.13, 53.96, 48.39 chains; find the area of the field in acres.

3. The diagonals of a quadrilateral enclosure are 17.21 and 24.32 chains, and the angle between them is 39° 14'; find the area of the enclosure, true to the hundredth part of an acre.

4. A room 40 ft. long, 22 ft. wide, and 15 ft. high has four windows on one side, each occupying a space 7 ft. wide and 13 ft. high; two doors, each 4 ft. 9 inches wide and 8 ft. high; and two fireplaces, each 5 ft. 8 inches wide, and 4 ft. 6 inches high; find the number of square yards of painting required for the walls, allowing 1 ft. for the height of the cornice and 15 inches for the skirting board.

5. The parallel sides of a trapezoid are 39 and 56 yards and the angles which the other two sides make with the longer side are 45° and 57°. Find the area.

Subject No. 8.

LINEAR DRAWING.

1. Draw a scale of $5\frac{1}{2}$ inches to a mile to read to 10 yards.

2. Construct a scale of miles and tenths having for its representative fraction $\frac{1}{63360}$.

3. Draw 4 parallel lines 4.5 inches long, 1-10 inch apart—first, Dark; second, Fine; third, Simple dotted; fourth, Chain dotted.

4. Construct an equilateral triangle 2.5 inches high.

5. Construct a square 1.5 inches in side and describe about it a circle in dots; describe two other circles concentric with first, one $\frac{1}{10}$ inch outside and the other $\frac{2}{10}$ inch inside.

6. Describe a circle 1.85 inches in diameter. Assume a point 1.5 inches without it and from it draw a tangent to circle.

Subject No. 9.

GEOGRAPHY.

1. Name the oceans of the world and the directions of the chief routes of travel.

2. Describe the chief mountain ranges and mention any special features you know about them.

3. Name the counties and districts of Ontario which border on the great lakes and the chief harbors in each.

4. Describe the motions of the sun, the moon, and the earth. How do they influence the length of day and the seasons in the several parts of the globe? Explain standard time and its advantages and disadvantages.

5. Define longitude and latitude: from what points are distances on them measured? Are they natural or artificial? Name and describe the zones.

Subject No. 10.

CANADIAN HISTORY.

1. Give the boundaries, the Provinces, and the area of the Dominion of Canada.

2. Give date of capture of Quebec, and names of opposing parties and commanders.

3. Who were the United Empire Loyalists, and where did they chiefly settle?

4. At what date and under what authority did Parliamentary Government begin in Canada, and give date and place of meeting of first Parliament of Upper Canada?

5. What caused the war of 1812? Give the names of some of the battles, and the respective commanders?

6. When were Upper and Lower Canada united, and give the terms of the Union?

7. When were postage stamps introduced in Canada, and when did Canada get the control of the post-offices?

8. Describe some of the steps towards Confederation, naming some of the leaders of both parties and date of and name of Act passed.

9. Name first Governor-General of the Dominion and first Prime Minister.

10. Name some of the principal events since Confederation.

11. Give the boundaries of the Province of Ontario.

12. Name the Prime Ministers of Canada since Confederation.

FINAL EXAMINATION.

Subject No. 1.

GEOMETRY.

Book I., Prop. 47. In any right angled triangle, the square which is described upon the side subtending the right angle is equal to the squares described upon the sides which contain the right angle.

The diameters of a parallelogram bisect each other.

Trisect a right angle.

If in the sides of a square, at equal distances from the four angles, four points be taken, one in each side, the figure formed by joining them will also be a square.

Book II., Prop. 11. To divide a given straight line into two parts, so that the rectangle contained by the whole and one of the parts shall be equal to the square of the other part.

Book III., Prop. 1, Cor. If in a circle one straight line bisect another at right angles, the centre of the circle is in the line which bisects the other.

Book III., Prop. 22. The opposite angles of any quadrilateral figure inscribed in a circle are together equal to two right angles.

If this be so, show that a circle may be described about it, and find its centre and radius.

Book IV., Prop. 6. To inscribe a square in a given circle.

Book IV., Prop. 10. To describe an isosceles triangle, having each of the angles at the base double of the third angle.

Upon a given straight line describe a regular octagon.

Book VI. Define "Similar rectilineal figures," "Reciprocal figures," "Extreme and Mean ratio."

Book VI., Prop. 6. If the two triangles have one angle of the one equal to one angle of the other, and the sides about the equal angles proportionals, the triangles shall be equiangular, and shall have those angles equal which are opposite to the homologous sides.

Prop. 19. Similar triangles are to one another in the duplicate ratio of their homologous sides.

Subject No. 2.

ALGEBRA.

1. Extract the square root of:

$$4x^4 - 4x^3 + 5x^2 - 2x + 1$$

and the cube root of 10980.645048.

2. Solve: $7x^2 - 3x = 160$ (a)

$(3x - 2)(x - 1) = 14$ (b)

3. The product of two numbers is 750 and the quotient when one is divided by the other is 3. Find the numbers.

4. When are quantities in

(a) Arithmetical progression.

(b) Geometrical progression.

Give examples.

5. Show how many terms of 3, 4, 5, etc., make 25.

Sum to infinity: $5 - \frac{1}{2} + \frac{1}{2^2 5} - \frac{1}{2^3 5^2} \ldots\ldots\ldots\ldots$

Subject No. 3.

TRIGONOMETRY (PLANE AND SPHERICAL).

1. Prove the truth of the following rule in surveying: Take $\frac{1}{33}$ of the square of the distance in chains and it will give the correction for curvature in inches.

2. The sun's distance from the earth being 24,000 times the earth's radius, find (in seconds) the earth's apparent diameter as seen from the sun.

3. The sine of a certain angle is $\frac{3}{5}$. Find the other trigonometrical ratios of the angle.

4. Give the definition of sphere, pole, great and small circle and spherical polygon.

5. Prove that $\tan \frac{A}{2} = \sqrt{\frac{\sin (s-b) \sin (s-c)}{\sin s \sin (s-a)}}$.

6. Prove that $\tan \frac{1}{2}(A+B) = \frac{\cos \frac{1}{2}(a-b)}{\cos \frac{1}{2}(a+b)} \cot \frac{C}{2}$.

7. In a right angled Spherical Triangle, given $a = 37^\circ\ 48'\ 12''$, $b = 59^\circ\ 44'\ 16''$, $C = 90^\circ$. Find c, A and B.

8. In an oblique angled spherical triangle, given $a = 68^\circ\ 20'\ 25''$, $b = 52^\circ\ 18'\ 15''$, $C = 117^\circ\ 12'\ 20''$. Find A and B.

Subject No. 4.

MENSURATION AND LAYING OUT LAND.

1. The sides of a quadrilateral, taken in order are 75, 55, 60, and 40 inches, and the angle between the first two sides is 74° 40' 15"; show that the figure may be inscribed in a circle, and find its area in square feet.

2. The sides of a triangular field are 32.13, 33.96, 48.39 chains; find the area of the field in acres.

3. Two sides of a parallelogram are 10.62 and 15.35 chains, and the angle between them is 30°. Find the area.

4. One side of a quadrilateral field is 11.1 chains and the perpendiculars from the opposite corners are 3.52 and 5.95 chains; the foot of one perpendicular is distant 1.1 chains from one end of the given side and the foot of the other 3.65 chains from the other end. Find the area.

5. Let DA bear S. 20¼° W.; AB, N. 51½° W., 8.19 chain B.C. N. 73½° E., and let it be required to part off two acres by a line fence D.C. running N. 45° W.

6. What is a traverse table? Explain fully how you would use such a table to calculate the area of an irregular field. What means does such a table afford to enable you to check the accuracy of the work as you progress?

7. Let BA bear S. 30° E., BC N. 80° E., and a fence be required to run from some point in BA a due north course and to part off one acre. Required the distance from the point B to the point F, whence it must start.

8. A field is bounded thus N. 14° W., 15.20 chains, N. 70½° E., 20.43; S. 6° E., 22.76; N. 86½ W., 18.00. A spring within it bears from the second corner S. 75° E. 7.90. It is required to cut off ten acres from the west side of the field by a straight fence through the spring. How far will it be from the first corner to the point at which the division fence meets the fourth side?

9. AB bears N. 13° W., 12.50 chains; BC N. 89°, E. 16.48 chains, CD, S. 13° E. 4.83. DA is a curved line having a radius of 1584 feet. You are required to divide the field into two equal parts by a line drawn parallel to AB and find area of field.

10. What is Simpson's rule for areas of irregular figures? Illustrate and prove the truth of it.

Subject No. 5.

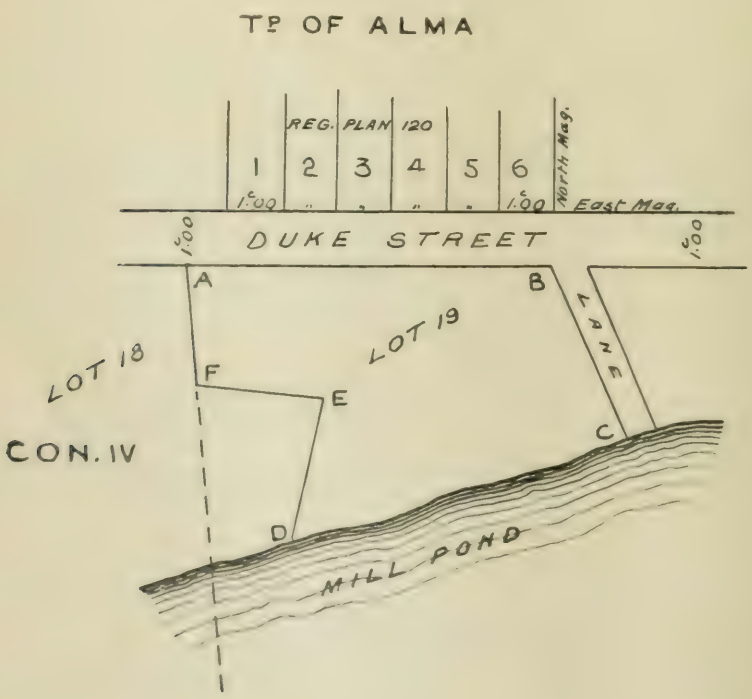
DESCRIPTIONS BY METES AND BOUNDS.

1. Correct the errors in this description:

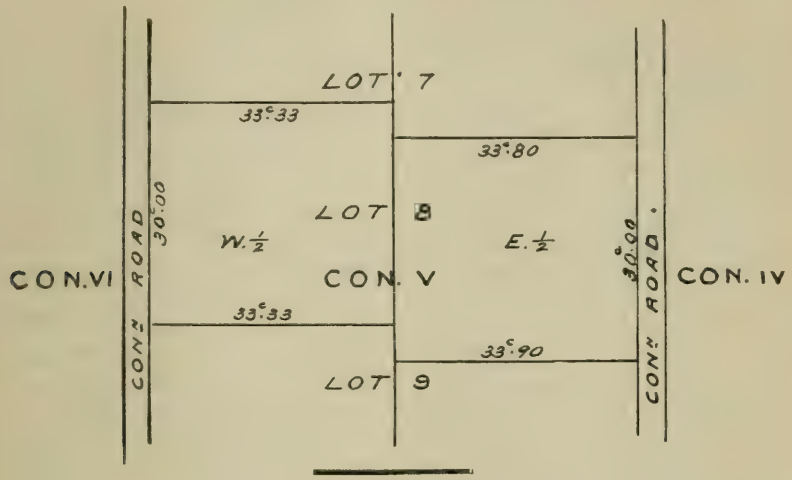
Description of five acres of land, being part of Township Lot 123. Commencing at the north-east angle of said half acre or north-west angle of John Smith's lot; thence south to the Portage Road, 10 chains; thence west along said road 5 chains; thence north along J. Roe's property, 10 chains to stone; thence N. 10° E. 5 chains, to the place of beginning.

2. Give some cases in which it would be best to omit magnetic bearings and the term more or less.

3. Give description by metes and bounds of the property A, B, C, D, E, F shown in diagram, assuming bearings and distances where not given.



Give description of the centre twenty-five acres of the double front lot in diagram, for tax title.



SUBJECT NO. 7.

CURVES.

1. Explain the following terms:

Angle of Intersection; Deflection Angles; Tangent Points; Simple Curve; Compound Curves; Reversed Curves; Radius of Curve.

What is meant by the expression, "A five degree curve"?

2. Given angle of intersection =31° 16' and tangent =950. Find the radius.

3. (a) How do you find the length of a curve, angles of intersection and deflection being given? (b) Given I=8° 32' and D=1°. Find the length of curve.

4. Given angle of intersection =80°; degree of curve =3° 20'; point of intersection at station 2048+30. Where are the B C and E C?

Plot the curve and tangents on a scale of 400 feet to one inch, showing chainage at B C, E C and length of curve.

What angle would you turn off the tangent at the B C to fix the first even station beyond the B C on the curve?

5. Given the perpendicular distance between two parallel tangents = 12 and the distance between two tangent points = 200, determine radius of reversing curves connecting them.

Subject No. 8.

PRACTICAL ASTRONOMY.

1. Define Azimuth circle, Polar distance, Hour angle and Co-declination.

2. Describe the process for taking, with a transit, at night, observation for altitude, of a star at its meridian passage, and define corrections necessary for calculation of latitude of place of observation.

3. Convert 1d. 11h. 40m. A. M. August, and October 9d. 10h. 1m. P.M. Civil Time into Astronomical Time.

4. When in latitude 48° 51' N. the sun's declination is 18° 30' N., and its altitude 52° 35s., what is its azimuth from the north ?

5. Find hour of observation in mean time at which the altitude of Procyon was 28° 10' 13" when east of the meridian in latitude 7° 45' N., its declination being 5° 41' 52" S., its right ascension 7° 29' 30" and that of the mean sun at mean noon 11° 4' 40".

6. The sun's right ascension and declination on the 8th September, 1854, 11 hrs. 6 min. 30.79 sec. and 5° 43' 52" 4 N., what will be its longitude and the obliquity of the ecliptic ?

Subject No. 9.

SURVEY ACT.

1. Who may act as a Land Surveyor in Ontario ?

2. When may Municipal Councils have boundaries of lots ascertained and marked ?

3. What is meant by a "Governing Line ?"

4. What is a "proof-line ?" and when should it be used ?

5. What is understood by the "front" of a concession ? and what is a "single front" concession ?

6. What is meant by "double front" concessions ? When was the system introduced ? and how are lines to be run in these concessions ?

7. Describe the sectional system of survey, when was it introduced ? and how are lines to be run therein ?

8. How are lines to be run in Muskoka and Parry Sound Districts and country adjacent thereto ?

9. When post between lots is lost, how do you establish point ?

10. How are lines to be run in those townships where side lines of lots were run in original survey ?

11. Oral examination.

Group No. 10.

(A) THE MINES ACT.

1. What may the dimensions of a mining location be in: (a) unsurveyed territory; (b) surveyed townships. Give all the cases which may occur.

2. Distinguish between a mining location and mining claim. Explain how to secure a mining location and mining claim.

3. Make a plan on a scale of 10 chains to an inch of a mining location lying on the south-easterly shore of a lake, shore line bears north 7° 30' east, magnetic where the magnetic variation is 8° to the west.

(B) THE REGISTRY ACT.

1. Give form of surveyor's certificate to a plan of sub-division for registration purposes.

2. Where land is surveyed and sub-divided for the purpose of being sold in lots by reference to a plan, when must the plan be registered, who shall sign it, what scale must it be drawn to, and what information must the plan contain ?

(C) THE DITCHES AND WATERCOURSES ACT.

1. "A" is the owner of Lot 1, Concession 2, in the Township of "Z." He is desirous of draining his land, and it is found necessary to continue the ditch through the following lands: Lots 2, 3, 4, 5, and 6, in Concession 2, owned by B, C, D, E, and F, respectively, across the road allowance between Concessions 2 and 1, in said township and through lots 6 and 7 in Concession 1, owned by G and H, respectively, to a natural outlet.

Explain, step by step, the procedure "A" will require to take in order to have an award made by the engineer. Cost of ditch, $980.

(D) THE DRAINAGE ACT.

1. Explain the following expressions and words: Initiating Municipality, Maintenance, Sufficient Outlet, Owner.

2. What persons are qualified under this Act to petition for the construction of drainage work. What number is required to begin proceedings. Give all the cases.

3. What do you understand by the terms: Benefit, Injuring Liability, Outlet Liability. How is the assessment for the last two determined.

4. What is the first duty of an engineer appointed under this Act?

5. Prepare a report, sketch plan and assessment for the proposed improvement of Lots 1, 2, 3, 4, 5, in Concessions Numbers 1 and 2, Township of "A," by the deepening, etc., of Bear Creek, in which all classes of assessment occur.

Subject No. 11.

LEVELLING.

1. Define the following terms with sketch, if possible:

Apparent Level, True Level, Datum Line, Bench Mark, Height of Instrument, Back Sight, Fore Sight, Intermediates, Five Per Cent. Grade, One Hundred Per Cent. Grade, 1 in 16 Grade, Turning Point, Refraction.

2. State with diagram (a) how to adjust a level, (b) how a levelling staff is constructed, (c) how a field book is prepared and levels reduced when back sights, fore sights, intermediate sights, and turning point sights are taken.

3. Prove that the difference between true and apparent level is equal to the square of the distance between the points.

4. If you are preparing a profile for a case in court, would you have the horizontal and vertical scales the same or different, and if different what should the ratio of the one to the other be and why?

5. What is the difference between true and apparent level at the distance of 3,100 feet?

6. Required the difference between true and apparent level, for a distance of 140 chains.

7. How would you eliminate error in adjustment of level and corrections for refraction and curvature of the earth in running a line of levels in the field, without calculations? Give reason for same.

Subject No. 12.

PRINCIPLES OF EVIDENCE.

1. What do you understand by the word "Evidence"?

2. What is the "best evidence"? "primary evidence"? "secondary evidence"? Explain under what conditions the latter is admissible.

3. Assuming you have good grounds to expect material evidence may be had from certain documents in the hands of the (a) adverse party, (b) a stranger. What steps would you take and by what means would you insure an examination of them?

4. What is hearsay evidence and when, if ever, is it allowable?

5. What is an affidavit? Give its essential parts, illustrating your reply by an affidavit to a post.

Subject No. 14.

GEOLOGY AND MINERALOGY.

1. Name the thirteen characteristic elements most important in rocks.

2. Name the three classes of minerals which are the principal constituents of rocks, and give two or more examples of each.

3. Name the two classes into which rocks may be conveniently divided and give three examples of each.

4. Distinguish between Calcite, Dolomite, and Hydraulic Limestone.

5. Define Tavertine and manner of formation.

6. Define Stratification, Layer, Stratum, Formation, Seam, Joint, Fault Folds, Dislocations, Dip, Strike, Anticlinal, Synclinal, Conformable, Fossils, Dike.

7. Name the six ages into which the formation of the earth's crust is divided.

8. Name in order, about eighteen, of the formations in Ontario.

9. Give a short account of the following formations: Huronian, Trenton, Utica, Hudson River, and Corniferous, giving economic products and fossils, etc., etc.

10. What is Gypsum? Where is it found in Ontario? Explain its origin and some of its uses.

11. Describe the Glacial Period, as to its Source, Geological Distribution, Materials, and Course of Travel.

12. Give a short Geological description of the surface of Ontario, north of Lakes Huron and Superior.

13. Name the valuable minerals and metals found in the part of Ontario mentioned in question 12.

14. Give a list of the principal economic minerals and metals mined in Ontario.

Subject No. 15.

BOTANY AND THE FOREST FLORA OF CANADA.

1. Describe the functions of leaves. How are they classified? Draw and describe any Canadian leaf you know.

2. What elementary substances should the soil contain for the nourishment of plants?

3. What is the difference between underground stems and roots?

4. Name six trees of Ontario. State their varieties and economic uses. Number them in order of value.

LIST OF MEMBERS.

21st September, 1899.

The names of those members granted exemption by By-laws ratified by the Association are marked*.

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

Abrey, George Brockitt, Sawbill, Dist. of Rainy River.....10th Jan., 1860
D.L.S.

Allan, John Richard, Renfrew.....6th Nov., 1894
Grad. S.P.S.

Aylsworth, Charles Fraser, Jr., Madoc.....8th Jan., 1886
D.L.S.

Aylsworth, John Sidney, Selby, P.O. Box 23...9th Jan., 1871
D.L.S.

Aylsworth, William Robert, Belleville, P.O. Box 2.....8th Nov., 1861
D.L.S.

Baird, Alexander, Leamington.....7th July, 1877
D.L.S., C.E.

Barrow, Ernest George, Hamilton.....4th Oct., 1877
D.L.S., Mem. Can. Soc. C.E., City Engineer.

Bazett, Edward, Burk's Falls.....8th July, 1881
D.L.S.

Beatty, David, Parry Sound.....12th July, 1869
D.L.S.

Beatty, Herbert John, Eganville.....8th Nov., 1893
Grad. S.P.S.

Beatty, Walter, Delta.....19th July, 1858
D.L.S., M.P.P.

Bell, James Anthony, St. Thomas.....11th Oct., 1875
D.L.S., Co. Engineer, Elgin; City Engineer, St. Thomas.

Bigger, Charles Albert, Ottawa, 68 Daly Ave..6th Jan., 1882

Bolger, Thomas Oliver, Kingston.....6th July, 1865
D.L.S., City Engineer.

Bolton, Ellsworth Doan, Listowel ..... 7th Nov., 1895
B.A.Sc. (McGill)

Bolton, Lewis, Listowel.....9th July, 1864
D.L.S.

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

Boswell, Elias John, Peterborough.....7th Nov., 1896
Grad. S.P.S.

Bowman, Clemens Dersteine, West Montrose. 10th July, 1879

Bowman, Herbert Joseph, Berlin.....7th Jan., 1887
D.L.S., Grad. S.P.S., Treasurer County Waterloo. Assoc. Mem. Can. Soc. C.E.

Bray, Edgar, Oakville.....6th Oct., 1866
D.L.S.

Bray, Harry Freeman, Oakville.....10th July, 1882

Bray, Samuel, Ottawa, Dept. of Indian Affairs..6th Jan., 1877
C.E., D.L.S.

Brown, David Rose, Cornwall.....10th Oct., 1850
D.L.S.

Brown, George Laing, Morrisburg.....19th Feb., 1898
Grad. S.P.S.

*Brown, John Smith, Kemptville.....8th July, 1852
D.L.S.

Browne, Harry John, Toronto, 18 Toronto st..6th July, 1872
C.E.

Browne, William Albert, Toronto,
18 Toronto st.....10th April, 1876

Burt, Frederick Percy, New York, N.Y.....8th July, 1885
Manager and Treasurer Engineering News Pub. Co., 220 Broadway.

Butler, Matthew Joseph, Napanee,
P.O. Box 359.....11th Jan., 1878
M.I.C.E., Mem. Am. Soc. C.E., Mem. Can. Soc. C.E., C.E.

Byrne, Thomas, Sault Ste. Marie.....15th July, 1862
D.L.S.

Caddy, Cyprian Francis, Campbellford.....10th July, 1860
D.L.S.

Caddy, John St. Vincent, Ottawa, 559 King st..6th Oct., 1866
D.L.S.

Cameron, Alfred John, Peterborough.....9th April, 1889

Campbell, Archibald William, Toronto,
Parliament Building .....10th April, 1885
C.E. Provincial Instructor in Road Making.

Carpenter, Henry Stanley, B.A., Sc.
(Toronto Univ.), Collingwood ..... 25th Feb., 1899

Carre, Henry, Belleville, P.O. Box 203.....8th Nov., 1861
City Engineer, B.A. and C.E. (Trin. Coll., Dublin), D.L.S.

Carroll, Cyrus, Rat Portage.....10th Jan., 1860
Mem. Can. Soc. C.E., D.L.S.

Casgrain, Joseph Philippe Baby, Morrisburg...5th Jan., 1887
D.L.S., P.L.S., Que., C.E., Assoc. Mem. Can. Soc., C.E., Chief Eng. M. &

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

Cavana, Allan George, Orillia.....8th July, 1876
D.L.S.

Chalmers, John, Rat Portage.....14th April, 1896
Grad. S.P.S.

Charlesworth, Lionel Clare,
Port Arthur O. & R. R. Co.....14th April, 1896
Grad. S.P.S.

*Cheesman, Thomas, Mitchell.....11th July, 1856
D.L.S.

Chipman, Willis, Toronto, 103 Bay st.....4th Oct., 1881
B.A. Sc. (McGill), Mem. Am. Soc., Mem. Can. Soc. C.E.

Code, Abraham Silas, Alvinston.....14th April, 1896

Cozens, Joseph, Sault Ste. Marie.....7th July, 1875
D.L.S.

*Davidson, Alexander, Arkona.....11th Oct., 1858
D.L.S.

Davidson, Walter Stanley, Sarnia.....9th April, 1884

Davis, Allan Ross, Napanee .....8th Jan., 1886
B.A.Sc. (McGill.)

Davis, John, Alton.....5th April, 1878

Davis, William Mahlon, Berlin .....11th April, 1885
Grad. R. M. Coll., (Kingston), Town Engineer.

Deacon, Thomas Russ, Rat Portage.....12th Nov., 1892
Grad. S.P.S., Town Engineer.

Deans, William James, Oshawa.....11th July, 1884

DeMorest, Richard Watson, Sudbury.....9th April, 1889
M.E.

Dickson, James, Fenelon Falls.....6th April, 1867
D.L.S.

Dobbie, Thomas William, Tilsonburg.....11th July, 1856
D.L.S.

Dobie, James Samuel, Port Arthur.....21st Feb., 1898
B.A.Sc. (Toronto).

Doupe, Joseph, Winnipeg, Man.,
169 Edmonton st.....13th Jan., 1863
D.L.S., P.L.S. (Man.), C.E. (McGill).

Ducker, William A., Winnipeg, Man.,
334 Pacific ave.....6th April, 1882
D.L.S., P.L.S. (Man.)

Esten, Henry Lionel, Toronto, 157 Bay st....7th Jan., 1887

Evans, John Dunlop, Trenton.....8th July, 1864
D.L.S., C.E., Chief Eng. Cent. Ont. Ry., Eng. for Weddell Bridge & Engine Works.

Fair, John, Brantford.....13th April, 1875

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

Fairbairn, Richard Purdom, Toronto,
127 Major st.....7th Oct., 1876
Surveyor for Dept. of Pub. Works.

Fairchild, Charles Court, Simcoe.....9th April, 1894
Grad. S.P.S.

Farncomb, Alfred Ernest, Fort William.....9th April, 1895

Farncomb, Frederick William, London,
213 Dundas st.....6th Nov., 1889

Fawcett, Thomas, Ottawa, Dept. of Interior...6th Jan., 1881
Dom. Topographical Surveyor.

Fitton, Charles Edward, Orillia, Box 142....10th April, 1879
D.L.S.

FitzGerald, James William, Peterborough,
Box 333.....13th July, 1857
D.L.S.

Flater, Frederick William, Petrolea.....9th April, 1888

Ford, William Butterton, Hamilton,
42 James St. N. .....21st Feb., 1898

Francis, John James, Sarnia P.O., Box 304...16th Oct., 1861
D.L.S.

*Fraser, Charles, Wallaceburg.....5th Aug., 1847
D.L.S

Galbraith, William, Bracebridge.....4th April, 1883
D.L.S.

Gamble, Killaly, Toronto, 88 Charles st.....6th April, 1888
D.L.S., P.L.S. (Man.), Captain R.A. (Ret'd)

Gardiner, Edward, St. Catharines.....6th Jan., 1866
D.L.S.

Gaviller, Maurice, Collingwood, Box 164.....6th Jan., 1866
C.E. (McGill), D.L.S.

Gibbons, James, Renfrew.....15th April, 1890
Grad. S.P.S.

Gibson, Harold Holmes, Willowdale.....8th Sept., 1891

*Gibson, James Alexander, Oshawa.....7th April, 1855
D.L.S.

Gibson, Peter Silas, Willowdale.....10th July, 1858
C.E. M.S. (Mich. Univ.) D.L.S., Mem. Can. Soc. C.E., Engineer Tp. of York.

Gibson, Wilbert Silas, Willowdale.....21st Feb., 1898

Gillon, Douglas John, Fort Frances.....9th Nov., 1895
Grad. R.I.E. Coll.

Graydon, Aquila Ormsby, London.....8th July, 1880
City Engineer.

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

Griffin, Albert Dyke, Woodstock,
P.O. Box 612.....11th Nov., 1890

Hanning, Clement George, Preston,
Lock Box 130.....19th July, 1858
D.L.S., C.E, (Trin. Coll., Dublin).

Hart, Milner, Toronto, 103 Bay st.....11th July, 1863
D.L.S.

Harvey, Thomas Alexander, Steelton, Penn...13th Nov., 1893
C.E. (R.P.I., Troy, N.Y.)

Heaman, John Andrew, London,
Albion Building.....16th Nov., 1896

Henry, Frederick, London, Albion Building..7th April, 1887

*Hermon, Royal Wilkinson, Rednersville....13th July, 1857
D.L.S.

Hobson, Joseph, Montreal, G. T. Ry. Office..3rd Oct., 1855
D.L.S., Chief Eng. Grand Trunk Railway System.

Hopkins, Marshall Willard, Rat Portage....13th Nov., 1893
B.A.Sc. (McGill), Assoc. Mem. Can. Soc. C.E., Chief Engineer I.R.R. Co.

Hutcheon, James, Guelph.....10th Nov., 1891
Grad. S.P.S., City Engineer.

Irwin, James Moore, Rat Portage..... 13th Jan., 1863
D.L.S.

James, Darrell Denman, Toronto,
77 Victoria St. .....3rd Nov., 1891
B.A., B.A.Sc. (Toronto University).

James, Silas, Toronto, 77 Victoria st.....19th July, 1858
D.L.S.

Jones, Charles Albert, Petrolea.....8th April, 1881
D.L.S.

Jones, John Henry, Sarnia, Box 194 .....10th Oct., 1863
D.L.S.

Jones, Thomas Henry, Brantford.....10th Oct., 1878
City Engineer, B.A.Sc. (McGill). D.L.S.,

*Keefer, Thomas Coltrin, Ottawa.....14th Aug., 1840
D.L.S., C.E.

Kennedy, James Henry, Penticton, B.C. .....7th April, 1887
C.E. (Toronto University), Mem. Can. Soc. C.E., Engineer of V.V. & E. Ry.

Kippax, Hargreaves, Huron, South Dakota...7th July, 1877
C.E. (Toronto University), Assistant to Surveyor-General.

*Kirk, Joseph, Stratford P.O., Box 373.....16th Feb., 1843
D.L.S.

Kirkpatrick, George Brownly, Toronto,
Dept. of Crown Lands.....13th April, 1863
D.L.S., Director of Surveys.

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

Laird, James Stewart, Essex.....6th April, 1867
D.L.S.

Laird, Robert, Rat Portage.....11th Nov., 1887
Grad. S.P.S.

Lewis, John Bower, Ottawa, Brunswick House .....4th Oct., 1883
D.L.S., P.L.S. (Quebec), C.E.

Lougheed, Aaron, Port Arthur.....12th Nov., 1888
D.L.S.

*Low, Nathaniel Edward, Wiarton.....11th July, 1856
D.L.S.

Lumsden, Hugh David, Toronto, 63 Homewood ave.....4th Jan., 1866
C.E., D.L.S., M.I.C.E., Mem. Can. Soc. C.E.

Macdougall, Allan Hay, Port Arthur.....11th April, 1859
D.L.S., Town Engineer.

Mackay, James John, Woodstock .....25th Feb., 1899

MacKenzie, William, Sarnia.....11th April, 1896
Grad. R.M.C. (Kingston).

MacKenzie, William Lyon, Cranbrook, B.C.....7th April, 1887
C.E.

MacPherson, Duncan, Montreal, P.Q.....9th Jan., 1884
Grad. R.M.C., M.I.C.E., Mem. Can. Soc. C.E., Div. Eng. Eastern Div. C.P. Ry.

McAree, John, Rat Portage.....6th April, 1867
Dominion Topographical Surveyor, B.A.Sc., (Toronto University).

*McCallum, James, Fort Frances.....30th Mar., 1849
D.L.S.

McCubbin, George Albert, St. Thomas, Box 423.....9th Nov., 1895
Asst. City Engineer.

McCulloch, Andrew Lake, Nelson, B.C.....10th Nov., 1888
Grad. S.P.S., Assoc. Mem. Can. Soc. C.E.

McDonell, Augustine, Chatham, 4 & 5 Ebert's Block.....11th July, 1863
D.L.S.

McDowall, Robert, Owen Sound.....11th Nov., 1890
Town Engineer, Grad. S.P.S.

McEvoy, Henry Robinson, St. Marys.....10th July, 1875
D.L.S.

McFadden, Moses, Neepawa, Man.....13th April, 1858
D.L.S., P.L.S. (Man.)

McFarlen, George Walter, Toronto, Court House.....11th Nov., 1889
Grad. S.P.S.

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

McGeorge, William Graham, Chatham, Box 225.....8th Jan., 1866
D.L.S.

McGrandle, Hugh, Huntsville.....5th Jan., 1883
D.L.S.

McKay, Owen, Windsor, P.O. Box 167.....7th Jan., 1887
Grad. S.P.S., Chief Eng. D. & L. E. Ry.

McKenna, John Joseph, Dublin.....9th July, 1860
D.L.S.

McLatchie, John, Nelson, B.C.....9th Jan., 1864
D.L.S., P.L.S. (Que., Man. and B.C.).

McLean, James Keachie, Elora.....8th April, 1876
D.L.S.

McLean, William Arthur, Toronto, Parliament Buildings .....21st Feb., 1898
Secretary of Roads.

McLennan, Murdoch John, Williamstown...13th Nov., 1893
B.A.Sc. (McGill), D.L.S.

McLennan, Roderick, Toronto, 115 Avenue Rd.....20th June, 1846
D.L.S.

McNab, John Duncan, Owen Sound.....9th Oct., 1879

McNaughton, Finlay Donald, Cornwall..... 25th Feb., 1899

McPherson, Archibald John, Brockville.....10th April, 1897
B.A.Sc. (Toronto).

McPherson, Charles Wilfrid, Toronto.....21st Feb., 1899

McPhillips, George, Winnipeg.....9th July, 1885
D.L.S., P.L.S. (Man.)

Manigault, William Mazyck, Strathroy, P.O. Box 300.....8th July, 1876
D.L.S.

Marshall, James, Holyrood.....6th Oct., 1866
D.L.S.

Meadows, William Walter, St. Thomas.....21st Feb., 1898
Grad. S.P.S.

Miles, Charles Falconer, Rat Portage, Hilliard House.....13th Jan., 1862
D.L.S.

Miller, Frederick Fraser, Napanee.....8th Jan., 1885

Moore, John MacKenzie, London, Albion Building.....9th Oct., 1879

Moore, John Harrison, Smith's Falls.....11th Nov., 1889
Grad. S.P.S.

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

Morris, Alfred Edmund, Perth.....10th April, 1879

Morris, James Lewis, Pembroke.....7th July, 1886
D.L.S., C.E. (Toronto University).

Mountain, George Alphonse, Ottawa.....9th Jan., 1884
Mem. Can. Soc. C.E., D.L.S., P.L.S. (Que.) Chief Eng. Can. Atlantic and O.A. & B. Rys.

Murdock, William, Toronto, 37 Bloor St. E.....10th Jan., 1860
D.L.S., C.E.

Murphy, Charles Joseph, Toronto, 157 Bay st..6th Oct., 1886

Newman, John James, Windsor.....21st Feb., 1898

Newman, William, Windsor,
57 Sandwich st. w.....12th Nov., 1892
Grad. S.P.S.

Niven, Alexander, Haliburton.....8th July, 1859
D.L.S.

Ogilvie, William, Dawson City, Yukon Dist..12th July, 1869
D.L.S., Commissioner for Yukon District.

O'Hara, Walter Francis, Chatham.....14th April, 1892
D.L.S.

Paterson, James Allison, Hamilton,
53 Erie Ave.....5th April, 1878
C.E., Mem. Can. Soc. C.E.

Patten, Thaddeus James, Little Current.....5th Jan., 1883

Peterson, Peter Alexander, Montreal, P.Q...16th July, 1863
D.L.S., C.E., Mem. Can. Soc. C.E., Chief Engineer Can. Pac. Ry.

Pinhey, Charles Herbert, Ottawa,
630 Wellington ave.....12th Nov., 1888
D.L.S., Grad. S.P.S., Assoc. Mem. Can. Soc. C.E.

Proudfoot, Hume Blake, Sawbill .....6th Jan., 1882
D.L.S., C.E. (Toronto University).

Rainboth, Edward Joseph, Ottawa.....11th Nov., 1887
D.L.S.

Rainboth, George Charles, Aylmer, Que....11th July, 1868
D.L.S., P.L.S. (Que.)

Reinhardt, Carl, Montreal, 340 Mountain St....25th Feb., 1899
B.A.Sc. (McGill.)

Ritchie, Nelson Thomas, Dryden.....9th Nov., 1888

Roberts, Vaughan Maurice, St. Catharines...5th April, 1887

Robertson, James, Glencoe.....11th July, 1885
Grad. S.P.S.

Robinson, Franklin Joseph, Barrie.....21st Feb., 1898
Grad. S.P.S.

Roger, John, Mitchell.....10th Nov., 1888
Grad. S.P.S.

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

*Rombough, William R., Toronto,
61 Walton St.....14th Nov., 1848
D.L.S.

Rorke, Louis Valentine, Sudbury.....14th April, 1890
D.L.S.

Ross, George, Welland.....10th July, 1879
B.A.Sc. (McGill), D.L.S.

*Rubidge, Tom S., Cornwall.....9th Feb., 1849
D.L.S., Asst. Eng. Dept. Rys. and Canals.

Russell, Alexander Lord, Port Arthur.....16th April, 1873
D.L.S.

Sankey, Villiers, Toronto, City Hall.....11th Jan., 1878
Grad. R.I.E. Coll., D.L.S., City Surveyor.

Saunders, Bryce Johnston, Fort William.....7th Jan., 1885
B.A.Sc. (McGill), D.L.S.

Scane, Thomas, Ridgetown.....7th Jan., 1865
D.L.S.

*Schofield, Milton C., Guelph.....28th Sept., 1843
D.L.S.

Schwitzer, John Edward, Rat Portage.....16th Nov., 1896
B.A.Sc. (McGill.)

Seager, Edmund, Rat Portage.....8th July, 1861
D.L.S.

Selby, Henry Walter, Dinorwic, C. P. Ry.....8th Jan., 1876
D.L.S.

Sewell, Henry DeQuincy, Rat Portage.....9th July, 1885
D.L.S., A.M.I.C.E.

Silvester, George Ernest, Sudbury.....12th Nov., 1892
Grad. S.P.S.

Sing, Josiah Gershom, Meaford, P.O. Box 3.....9th Jan., 1879
D.L.S.

Smith, Angus, Ridgetown.....14th April, 1896
Grad. S.P.S.

Smith, George, Woodville, Box 77.....7th April, 1881
Engineer for Co. Victoria and four Townships.

Smith, Henry, Toronto, Crown Lands Dept...8th Nov., 1861
Supt. Colonization Roads, D.L.S., Mem. Can. Soc. C.E.

Speight, Thomas Bailey, Toronto,
Yonge St. Arcade.....6th Jan., 1882
D.L.S.

Squire, Richard Herbert, Brantford,
30 Arthur st.....14th April, 1896
B.A. Sc. (Toronto University.)

Steele, Edward Charles, Port Arthur.....9th April, 1889

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

Stewart, Elihu, Collingwood.....8th April, 1872
D.L.S.

*Stewart, George Alexander, Calgary, Alta....8th July, 1852
D.L.S.

Stewart, John, Montreal.....11th Nov., 1887
D.L.S.

Stewart, Walter Edgar, Aylmer.....12th April, 1892

*Strange, Henry, Rockwood.....30th Nov., 1838
D.L.S., C.E

Tiernan, Joseph Martin, Tilbury Centre.....7th Jan., 1886

Traynor, Isaac, Dundalk.....16th April, 1873
D.L.S.

Turnbull, Thomas, Winnipeg, Man.,
C. P. R. Office.....6th July, 1878
D.L.S., C.E. (Toronto University).

Tyrrell, James Williams, Hamilton,
42 James st. n.....8th April, 1885
Co. Eng. for Wentworth, C.E. (Toronto University), D.L.S.

*Unwin, Charles, Toronto, 126 Seaton st....12th April, 1852
D.L.S.

Ure, Frederick John, Woodstock.....7th April, 1887
C.E.

Van Buskirk, William Fraser, Stratford.....7th April, 1888
Grad. R. M. Coll.

Van Nostrand, Arthur J., Toronto,
Yonge St. Arcade.....30th Oct., 1882
D.L.S.

Wadsworth, Vernon Bayley, Toronto,
103 Bay st.....9th April, 1864
D.L.S.

Wagner, William, Ossowo, Man.....13th April, 1858
D.L.S.

Walker, Alfred Paverley, Toronto, Room 508,
Union Station, C. P. Ry., Eng. Office.....6th Jan., 1882
D.L.S., Mem. Can. Soc. C.E.

Wallace, Charles Hugh,
36 Dame St., Dublin, Ireland.....9th Nov., 1880
D.T.S., C.E. (Trin. Coll., Dublin),

Wallace, James Nevin, Hamilton,
119 Hunter St. N. .....21st Feb., 1898
B.A., B.E. (Trin. College, Dublin).

Ward, Archeson Thomas, Toronto,
Yonge St. Arcade.....10th April, 1897

Warren, James, Walkerton, Box 190.....7th Oct., 1864

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

Watson, John McCormack, Orillia,
P.O. Box 224.....13th April, 1892

*Weatherald, Thomas, Goderich,
P.O. Box 273.....12th Jan., 1856
D.L.S., C.E.

West, Robert Francis, Orangeville.....7th April, 1881

Wheelock, Charles Richard, Orangeville.....7th Jan., 1886
Treasurer County of Dufferin.

Whitson, James Francis, Toronto,
Crown Lands Dept.....9th Jan., 1886

Wicksteed, Henry King, Cobourg.....7th Jan., 1886
D.L.S., C.E.

Wiggins, Thomas Henry, Cornwall.....10th Nov., 1891
Grad. S.P.S., D.L.S., Town Engineer.

Wilde, John Absalom, Sault Ste. Marie.....9th April, 1889

Wilkie, Edward Thomson, Carleton Place...11th April, 1891
D.L.S.

Williams, David, Kingston, 220 Queen St.....9 April, 1864
D.L.S.

*Winter, Henry, Thornyhurst.....11th July, 1853
D.L.S., C.E.

*Wood, Henry O., Billings' Bridge.....10th Oct., 1855
D.L.S.

*Yarnold, William Edward, Port Perry,
P.O. Box 44.....7th April, 1854
D.L.S.

REGISTERED AND WITHDRAWN.

The names of those who have become "Associates" under By-law No. 39 are marked*.

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

Anderson, John Drummond, Trail, B.C.....13th April, 1892

Apsey, John Fletcher, Cumberland,
Queen City Hotel, Md.....6th Jan., 1886
Grad. S.P.S

Aylsworth, Charles Fraser, sr., Madoc .....2nd April, 1861
D.L.S.

Blake, Frank Lever, Toronto,
Meteorological Office .....13th April, 1875
D.L.S.

Bell, Andrew, Almonte.....6th Oct., 1866
D.L.S.

Bolton, Jesse Nunn, 264 Major St., Toronto.....6th April, 1867
D.L.S.

Booth, Charles Edward Stewart,
Westmount, P.Q.....6th April, 1882

Bowman, Arthur Meyer, Mahan,
Beaver Co., Pa.....11th Nov., 1887
Grad. S.P.S., Staff of U.S. Engineers.

Bowman, Franklin Meyer, Bellevue,
Allegheny Co., Pa.....11th April, 1892
Grad. S.P.S., Engineer Structural Iron Works.

Brady, James, Victoria, B.C., Box 815.....15th July, 1862
M.E.

Burnet, Hugh, Victoria, B.C.....5th April, 1887
P.L.S. (B.C.).

Cambie, Henry John, Vancouver, B.C.....8th July, 1861
P.L.S. (B.C.).

Coleman, Richard Herbert, Toronto, Canada
Co. Offices, Imperial Bank Chambers....6th Oct., 1877

Drewry, William Stewart, Ottawa,
Dept. of the Interior ....5th April, 1883
D.L.S.

Edwards, George, Thurso, Que.....6th Jan., 1866
D.L.S.

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

*Ellis, Henry Disney, Kuching, Sarawak, Borneo ..... 7th April, 1877
D.L.S., Commr. of Pub. Works and Surveys.

Galbraith, John, Toronto, School of Prac. Science ..... 13th April, 1875
M.A., D.L.S., Prof. Engineering, S.P.S.

Gibson, George, St. Catharines ..... 10th April, 1860
D.L.S.

*Gilmore, Robert, Toronto, 294 Huron st .... 11th April, 1856
D.L.S., C.E

Green, Thomas Daniel, Ottawa, Dept. of Indian Affairs ..... 7th Jan., 1885
D.L.S.

*Harris, John Walter, Winnipeg, Assm't Com. Dept ..... 6th Oct., 1866
P.L.S. (Man.), D.L.S.

Henderson, Eder Eli, Henderson P.O., Maine ..... 7th April, 1887
Grad. S.P.S.

Hermon, Ernest Bolton, Vancouver, B.C. .... 7th Oct., 1885
P.L.S. (B.C.), D.L.S.

Innes, William Livingstone, Simcoe, ... 14th April, 1892
C.E. (Toronto Univ.)

Jephson, Richard Jermy, Calgary, Alta ..... 7th April, 1877
P.L.S. (B.C.), D.L.S.

Johnson, Sydney Munnings, Greenwood, B.C. . 9th Nov., 1895

Johnston, Robert Thornton, 944 Amsterdam ave., New York, N.Y. ..... 9th April, 1899

Kains, Tom, Victoria, B.C. ..... 11th July, 1873
D.L.S., P.L.S. (B.C.).

*Klotz, Otto Julius, Ottawa, 437 Albert st ..... 6th Jan., 1876
C.E. (Mich. Univ.), Dominion Topographical Surveyor.

Lane, Andrew, Sparrow's Point, Md ..... 4th April, 1895
Grad. S.P.S., Draftsman Maryland Steel Co.

Lendrum, Robert Watt, South Edmonton, Alta ..... 8th Jan., 1874
D.L.S.

Livingstone, Thomas Chisholm, Winnipeg, Man. ..... 10th Jan., 1859
D.L.S.

MacLeod, Henry Augustus F., Ottawa, 340 Cooper st ..... 11th Oct., 1856
C.E., D.L.S.

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

*McMullen, William Ernest,, St. John, N.B..11th Nov., 1892
Asst. Eng. C. P. Ry.

Magrath, Charles Alexander, Lethbridge, Alta..1st Nov., 1881
B.A.Sc. (McGill), D.L.S., P.L.S. (B.C.).

Moore, Thos. Alexander, London South....12th Nov., 1892

Munro, John Vicar, New York, N.Y.,
359 West 31st st.....9th April, 1895

Pearce, William, Calgary, Alta.....12th Oct., 1872
D.L.S., P.L.S. (B.C.).

Ponton, Archibald William, Ottawa,
Dept. of Interior.....9th April, 1880
D.L.S.

Pope, Robert Tyndall,——— Ireland.....13th April, 1875
C.E., D.L.S.

Purvis, Frank, Mesa City, Arizona.....7th April, 1875

Reid, James Hales, Bowmanville, Box 35.....6th Oct., 1860
C.E., F.G.S.

Reid, John Lestock, Prince Albert, Sask.....8th April, 1870
D.L.S.

Reiffenstein, James Henry, Ottawa,
Dept. of the Interior .....16th April, 1873
D.L.S.

Reilly, William Robinson, London,
361 Simcoe st.....7th April, 1881
D.L.S., P.L.S. (Man.)

Rogers, Richard Birdsall, Peterborough.....9th Jan., 1879
B.A.Sc. (McGill), D.L.S.

Ross, Joseph Edmund, New Westminster,
B.C. .....11th Nov., 1890
P.L.S. (B.C.).

Sanderson, Daniel Leavens, Coral, Mich.....4th Oct., 1882

Shaw, Charles Æneas, Greenwood, B.C.....6th Oct., 1877
P.L.S. (B.C.).

Sherman, Ruyter Stinson, Vancouver, B.C..12th April, 1890
P.L.S. (B.C.).

Simpson, George Albert, Winnipeg Man.....7th Oct., 1864
C.E., D.L.S., M.P.

Spry, William, Toronto.....19th July, 1858
C.E., D.L.S.

*Stewart, Louis Beaufort, Toronto,
School of Prac. Science.....6th April, 1882
Dominion Topographical Surveyor, Lect. in Surveying.

Strathern, John, Vancouver, B.C.....5th Oct., 1876
P.L.S. (B.C.), D.L.S.

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

Taylor, William Verner, Anaconda, B.C.....7th Nov., 1896
Grad. S.P.S

Tracey, Thomas Henry, Vancouver, B.C.....8th April, 1870
P.L.S. (B.C.), C.E., D.L.S.

Vicars, John Richard Odlum, Kamloops, B.C..5th Jan., 1887
D.L.S., P.L.S. (B.C.).

Weekes, Abel Seneca, Westaskiwin, Alta....12th April, 1890
D.L.S.

Wheeler, Arthur Oliver, New Westminster, B.C. .....8th July, 1881
P.L.S. (B.C.), D.L.S.

Willson, Alfred, Toronto, Can. Co. Offices, Imperial Bank Chambers.....6th Oct., 1866
D.L.S., Commissioner Canada Company.

Wilkins, Frederick William, Ottawa, Dept. of the Interior.....6th Jan., 1877
Dominion Topographical Surveyor.

SUMMARY.

Active members subject to dues.....	202
Active members exempted from dues	20
Withdrawn from practice (including 8 Associates)	61
Dead	26
Total number enrolled since incorporation.....	309

Deceased Members.

NAME.	LATE RESIDENCE	DATE OF P L S CERTIFICATE	DATE OF O L S REGISTRATION.	DIED
Bolger, Francis	Lindsay	10th October, 1863	1892	3rd November, 1895.
Bowman, Leander Meyer	Toronto	14th April, 1892	1892	20th September, 1895.
Burke, William Robert	Ingersoll	5th April, 1878	1892	10th June, 1897.
Caddy, Edward C	Cobourg	18th December, 1846	1892	26th September, 1897.
Coad, Richard	Glencoe	8th October, 1879	1892	17th May, 1897.
Creswicke, Henry	Barrie	8th July, 1864	1892	22nd January, 1898
Cromwell, Joseph M O	Perth	1st October, 1846	1892	19th October, 1897.
Deane, Michael	Windsor	26th May, 1848	19th December, 1892	3rd April, 1897.
DeGurse, Joseph	Windsor	5th April, 1883	1892	22nd March, 1898.
Foster, Frederick Lucas	Toronto	9th April, 1863	1892	27th July, 1899.
Fowlie, Albert	Orillia	13th January, 1863	1892	—— April, 1898.
Gibbs, Thomas Fraser	Adolphustown	31st May, 1841	1892	17th April, 1893
Gilliland, Thomas Brown	Eugenia	11th July, 1868	25th January, 1896	14th December, 1898.
Haskins, William	Hamilton	5th July, 1855	1892	5th July, 1896.
Hewson, Thomas Ringwood	Hamilton	6th July, 1877	1892	21st October, 1898.
Howitt, Alfred	Gourock	12th January, 1856	1892	6th May, 1896.
Lynch-Staunton, Francis H	Hamilton	11th October, 1856	1892	11th June, 1899.
MacMillan, James Alexander	Calgary	6th January, 1877	24th December, 1894	—— ——, 1898.
MacNab, John Chisholm	Hamilton	8th January, 1880	1892	16th October, 1897.
Malcolm, Sherman Morgan	Blenheim	11th October 1858	1892	13th January, 1899
Ogilvie, John Henry	Rat Portage	8th April, 1876	24th April, 1894	21st September, 1898.
Pedder, James Robert	Doon	10th November, 1891	23rd December, 1892	17th January, 1897.
Robinson, William	London	—— May, 1846	1892	11th October, 1894.
Thomson, Augustus Clifford	Chicago	14th January 1861	1892	—— December, 1896.
Walsh, Thomas William	Simcoe	25th April, 1842	1892	14th March, 1895.
Wheelock, Charles John	Orangeville	—— ——, 1856	1892	4th July, 1897.

OBITUARY.

FREDERICK LUCAS FOSTER.

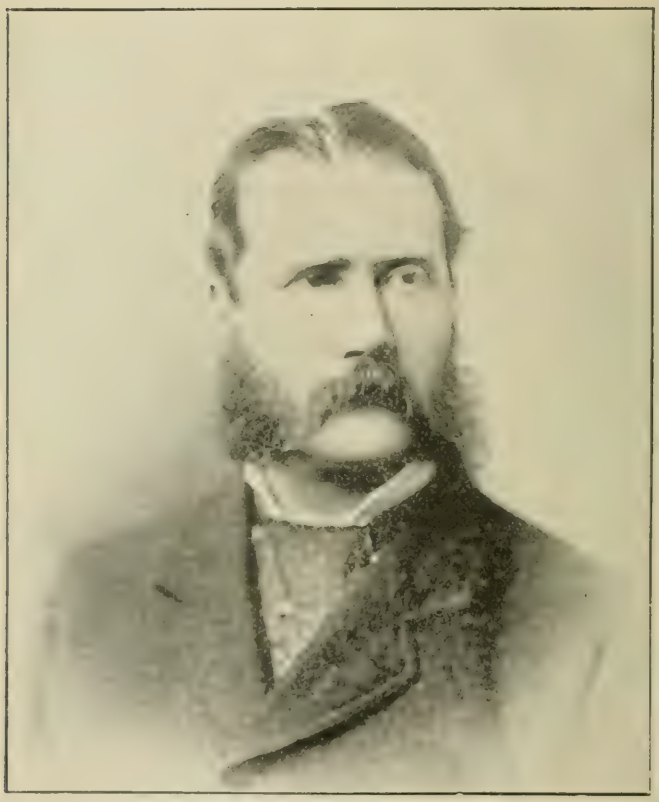
Our Vice-President Frederick Lucas Foster, whose decease we record with deep regret, was the son of Mr. Colley Foster, Barrister, and grandson of Colonel Foster, sometime Commander of Her Majesty's forces in Upper Canada. He was born in Toronto, on February 21st, 1842. After receiving his early education at Upper Canada College, he was for some time attached to the Military School in Toronto, and was a member of the Trinity College Rifle Corps. Having decided to embrace the profession of Land Surveyor, he was apprenticed to Mr. Charles Unwin, his cousin, on October 11th, 1858, and during his apprenticeship he was frequently occupied on government work with his eminent master. After completing his course with Mr. Unwin, and passing the requisite examination, he was sworn in as a Provincial Land Surveyor on April 9th, 1863. He commenced his professional career at Windsor, Ontario, in 1865. A good deal of Township work was entrusted to him, and the Government also employed him on the survey for defining the boundary between Canada and the United States along the St. Clair River. He was a member of the Council of Ontario Land Surveyors from 1895 to 1899. Mr. Foster was distinguished as a draughtsman, and made a plan of North America for the Ontario Government in 1884.

He was admitted as a member of the Ontario Society of Artists in 1888, and was for several years one of their Executive Council. Evidence of his ability as an artist have frequently appeared in the Annual Reports of the Land Surveyor's Proceedings.

In 1872 he married a daughter of Colonel D. D. Broadhead, of Boston, Mass., and two daughters, who survive him, were born of this union. His wife died in 1887.

Mr. Foster's simplicity of character, honesty of purpose and dignified gentlemanly bearing, are borne witness to by all who knew him; and in private life his gentleness and unselfish kindliness, endeared him to all with whom he has associated.

He died at Toronto, on July 27th, 1899.



FREDERICK LUCAS FOSTER.

FRANCIS HARDWICK LYNCH-STAUNTON.

Francis Hardwick Lynch - Staunton, the second son of George S. Lynch-Staunton, D.L., of Clydagh was born at his father's residence in Galway, Ireland, on August 15th, 1828. He was educated at the famous seminary of St. Mary's, Oscott, England.

He came to Canada in 1854, and received his commission as P.L. S. in October 1856. He practised as a Land Surveyor and Civil Engineer in the County of Bruce for ten years. He was also a Dominion Land Surveyor and was frequently employed in the North-West on Government work, between 1871 and 1883. He resided in West Flamboro', from 1865 to 1876, and in the latter year he went to Hamilton, where he continued to reside and practice his profession until his decease on June 11th, 1899. While in Hamilton, he was engineer in charge of the building of the old high level bridge, and of the H. and D. Railway. In 1860 he was appointed Lt.-Colonel of the 1st Battalion of the Co. of Bruce Militia. He was married to a daughter of the late George Corbett, of Kingston, and left nine children.

BY-LAWS OF THE

Association of Ontario Land Surveyors

AS REVISED 1899

(To take the place of all previous By-laws passed by the Association.)

Definitions in the following By-laws as defined by the "Ontario Land Surveyors' Act." Definitions

The word	"Association"	means	The Association of Ontario Land Surveyors.
"	"Council"	"	The Council of Management.
"	"Board"	"	The Board of Examiners.
"	"Chairman"	"	The Chairman of Council.
"	"Secretary"	"	The Secretary-Treasurer.

PREAMBLE.

The following By-laws are enacted under the powers granted by the Act respecting Land Surveyors"—Cap. 180, R. S. O., 1897. Authority for By-Laws.

THE ASSOCIATION.

1. The Annual General Meeting of the Association shall be held (as provided by the said Act) in the City of Toronto, on the fourth Tuesday in February in each year, at such place as may be selected by the Council. Annual Meeting of Association.

2. Special meetings of the Association may be called by the President, or shall be called by him at the written request of ten or more members. Special Meetings.

3. Due notice of such meetings shall be given by the Secretary to each member of the Association by circular letter posted to his registered address at least 10 days before any such meeting. Notice to be given by Secretary.

4. Fifteen members shall form a quorum at any meeting of the Association for the transaction of business. Constitution of quorum.

THE COUNCIL.

5. In addition to the duties assigned to the Council by the said Act, it shall have the direction and management of all the affairs of the Association, and shall appoint the several Standing Committees and name the Chairman of each. Duties of Council

Regular Meetings of Council

6. There shall be two regular meetings of the Council in each year, one to be held during the annual meeting of the Association, and one on the third Tuesday in April.

Special Meetings of Council.

7. Special meetings may be called by the President or Chairman.

Notice to be given by Secretary.

8. Due notice of every such meeting shall be given by the Secretary to each member of the Council.

Constitution of quorum.

9. At any meeting of the Council when business relating to the property or to the financial affairs of the Association is transacted, five members shall form a quorum; for the transaction of any other business three shall form a quorum.

Annual Report of Council.

10. The Council shall make a report of the affairs of the Association at the Annual Meeting, which report shall include the report of the Secretary and also of the Board of Examiners.

Board of Examiners to report to Council.

11. The Board of Examiners shall make a report to the Council at the Annual Meeting of the Association in each year.

STANDING COMMITTEES.

Standing Committees.

12. The Standing Committees shall be as follows: Each shall be composed of not less than 5 and not more than 9 members.

Committee on Land Surveying.
" Drainage.
" Engineering.
" Topographical Survey.
" Entertainment.
" Publication.

Duty of Standing Committees

13. Each Standing Committee appointed by the Council shall endeavor to advance the interests of the Association in that branch allotted to it.

Provision for Meetings.

Meetings of any Standing Committee shall be held at the call of the Chairman, three members to form a quorum.

Standing Committees to report to Association.

Each Standing Committee shall present to the Association, or to the Council, an Annual Report on the work done by said Committee.

ORDER OF BUSINESS AT MEETINGS OF ASSOCIATION.

Order of Business

14. The following shall be the order of business at the meetings of the Association:—

1. Reading of minutes of previous meeting.
2. Reading of correspondence.
3. Reports and papers.
4. Unfinished business.
5. New business.
6. Nomination of officers (if at the General Annual Meeting).
7. Adjournment.

RULES.

Procedure.

15. All motions must be in writing, and shall contain the names of the mover and seconder, and must be read from the Chair before being discussed.

Reports of Committees.

16. Reports of Committees must be in writing and signed by the Chairman thereof.

Rules of speech.

17. No member shall speak on any subject more than once, except the introducer of the subject, who shall be entitled to reply; every member, however, shall have the right to explain himself subject to the discretion of the Chairman.

Discussion Closed.

18. When a motion has been finally put to the meeting by the Chairman, all discussion thereon shall be closed.

Majority vote may re-open any motion.

19. Any motion may be re-opened by a majority vote of those present.

Appointment of Scrutineers.

20. The Chairman of the meeting shall appoint two scrutineers when a ballot is taken, as defined in sec. 22 hereof.

Speakers to Address the Chair.

21. Every member while speaking shall address the Chairman.

Voting at General or Annual Meetings.

22. All voting at any General or Annual Meeting shall be by standing vote, unless a ballot be demanded by at least two members.

Parliamentary rules to govern.

23. Parliamentary rules to govern in all cases not provided for in preceding sections.

DUTIES OF OFFICERS.

Presiding officer at Association meetings.

24. The President, or in his absence the Vice-President, shall preside at all meetings of the Association; in the absence of both, the meeting shall appoint a Chairman.

Presiding officer at Council Meetings.

25. The Chairman shall preside at all meetings of the Council; in his absence the meeting shall appoint a presiding officer.

Duties of Secretary-Treasurer.

26. In addition to the duties assigned to him by the said Act, the Secretary-Treasurer shall keep an accurate record of the proceedings at all meetings of both the Association and the Council in separate books, conduct all correspondence, announce all meetings, report the result of elections to the Commissioner of Crown Lands, the officers of the Association and the candidates for election, receive all fees and subscriptions and other moneys. He shall, under the direction of the Council, deposit all moneys in such bank or other financial institution as it may select. He shall pay no bills unless sanctioned by the Council and signed by the Chairman. All payments of $10.00 and upwards to be made by cheque, signed by the Secretary and countersigned by the President, or in his absence by the Chairman of the Council. He shall submit an account of all moneys received and paid by him under the said Act and these By-laws to the Council at the Annual General Meeting of the Association, and shall perform such other duties as may from time to time be assigned by the Council or the Association.

The Sec-Treas to give bond. Where they shall be deposited.

27. The Secretary-Treasurer shall give a bond in the usual form to the amount of $1,000, such bond to be in the custody of the President, and deposited in the bank where the funds of the Association are kept.

EXAMINATIONS.

Examination of candidates for apprenticeship.

28. Candidates for admission to apprenticeship are to be examined as follows, in the subjects prescribed in Rev. Stat. Ont., c. 180, s. 22; and no candidate shall be admitted unless he obtains at least the minimum marks set opposite each subject, and at least a total of 550.

Subject.	Max. Marks.	Min. Marks.
1. Penmanship	50	30
2. (*a*) Orthography (including dictation)	50	40
(*b*) English Grammar	50	25
3. Arithmetic (Fractions, Decimals, Square Root)	100	60
4. Logarithms and Algebra (including Equations 1st degree)	100	60
5. Euclid (Books 1, 2, 3 and 4)	100	60
6. Plane Trigonometry and Rules for Spherical	100	50
7. Mensuration of Superficies	50	30
8. Linear Drawing (use of ruling pen and construction of scales)	50	25
9. Canadian and General Geography	50	25
10. Canadian History	50	25

Examination of candidates for admission to practice.

29. Candidates for admission to practice are to be examined as follows in the subjects prescribed in Rev. Stat. Ont., c. 180, s. 25; and no candidate will be admitted unless he obtains at least the minimum marks set opposite each subject, and at least a total of 1,000.

Subject.	Max. Marks.	Min. Marks.
1. Geometry, including the first 6 books of Euclid, excepting the last thirteen propositions of the fifth book	100	50
2. Algebra (simple and Quadratic Equations, Progressions and Exponents)	100	50
3. Trigonometry (Plane and Spherical)	100	60
4. Mensuration of superficies and laying out and dividing land	150	75
5. Descriptions by metes and bounds	100	75
6. Use and Adjustment of Instruments for surveying and levelling	100	70
7. Laying out of Curves	50	30
8. Practical Astronomy, including finding of Time, Latitude, Longitude, Azimuth, Variation of Compass, and drawing Meridian Lines	150	90
9. Survey Act	150	90
10. Mines Act, Registry Act, Municipal Act, (so far as they relate to surveys and drainage), Ditches and Water-courses Act	100	50
11. Levelling	50	35
12. Principles of Evidence and drawing up Affidavits.	80	40
13. Taking of Field notes and preparing of Plans	100	60
14. Geology and Mineralogy, (rudiments of)	75	40
15. Elementary Botany and the Forest Flora of Canada	50	25

30. If a candidate for admission to practice obtains at least the total of 1,000 marks, but fails to obtain the minimum marks in, at least, two of the subjects, such candidate may at a subsequent examination be examined only in the two subjects in which he has failed.

The Board to regulate examinations.

31. The Board may make, from time to time, such regulations as it considers necessary for the proper carrying out of these examinations.

Complaints against members or any unlicensed practitioner to be filed with Secretary.

32. Any complaint against a member of the Association or against any unlicensed practitioner shall be filed with the Secretary, who shall immediately forward the same to the Chairman.

The Chairman may call a special meeting.

If the matter complained of is of a serious and pressing nature, the Chairman may, at his discretion, call a special meeting of the Council for the purpose of hearing said complaint; if not so acted on, the complaint shall be heard at the next regular meeting of the Council.

Procedure where the delinquent is a member.

In the case of a member of the Association, the Council shall take action as defined in the said Act.

Procedure where the delinquent is an unlicensed practitioner.

In the case of any unlicensed practitioner, the Council, if satisfied as to the justice of the charge, shall name a prosecutor and direct him as to his action in the conduct of the case, and shall allot such portion of the penalties, or authorize the payment of such fees as it may deem expedient.

The Council has power to pass By-laws

33. The Council shall have power to pass any By-law which it deems expedient for the good of the Association, and such By-law shall have the same force until the next Annual Meeting, as if it had been passed by the Association. Such By-law must be reported to the Association at the next Annual Meeting, and the action taken thereon. All members of the Association shall be notified by the Secretary of the passing of such By-law by the Council.

34. Grants exemption from dues, under 55 V. c. 34, s. 10 (4), to Henry Strange, Milton C. Schofield, William Robinson, Joseph Kirk, Charles Fraser, Joseph M. O. Cromwell, H. O. Wood, F. H. Lynch-Staunton and E. C. Caddy.

35. The annual fees to this Association paid by candidates admitted to practice at the session of the Board in February in any year shall cover the annual dues for the remainder of the then current Association year, and for the Association year immediately following the same.

36. Grants exemption from dues under 55 V. c. 34, s. 10 (4), to Thomas Coltrin Keefer, Nathaniel Edward Low, Thomas Cheesman, James McCallum and Thomas W. Walsh.

37. Grants exemption from dues under 55 V. c. 34, s. 10 (4), to Royal Wilkinson Hermon.

38. Reduced the number of minimum marks in the subject of "Levelling." (Obsolete.)

39. "Whereas any registered surveyor desiring to give up practice can have his name removed from the registered list of practitioners, at any time, upon giving written notice of such desire, and whereas it is desirable

that such surveyors may contribute papers and secure the reports of the transactions of this Association and exchanges, therefore this Council hereby enacts that such surveyors shall have the aforesaid privileges upon the payment of an annual fee of two dollars, and their names shall be printed in the list of members in the annual report of the Association and properly marked."

40. Grants exemption from dues, under 55 V. c. 34, s. 10 (4), to Tom S. Rubidge and James A. Gibson.

41. Grants exemption from dues, under 55 V. c. 34, s. 10 (4), to Charles J. Wheelock, Thomas Weatherald, Michael Deane, John Smith Brown, and William Edward Yarnold.

42. Grants exemption from dues, under 55 V. c. 34, s. 10 (4), to Alexander Davidson.

43. Grants exemption from dues, under 55 V. c. 34, s. 10 (4), to Charles Unwin, Wm. R. Rombough and Henry Winter.

44. Changes the name of "Committee on Topographical Surveying" to "Committee on Topographical Survey."

45. Whereas any registered surveyor desiring to give up practice can have his name removed from the list of practitioners upon giving written notice of such desire, and whereas it is desirable that such surveyors may contribute papers and secure the reports of the transactions of this Association, therefore it is hereby enacted that such surveyors shall have the aforesaid privileges upon the payment of an annual fee of one dollar, and their names shall be printed in the list of members in the annual report of the Association and properly marked.

46. Grants exemption from dues, under 55 V c. 34, s. 10 (4), to George Alexander Stewart.

RULES AND REGULATIONS

OF THE

Board of Examiners for Ontario Land Surveyors.

Adopted by the Board of Examiners.

1. The examination sittings shall commence each day at 9.30 a.m., continue until 12.30 p.m., recommence at 1.30 p.m., and continue until 4.30 p.m., day by day until completed, subject to the direction of the Board.

2. All the papers will be collected at the close of each sitting, and candidates will not be permitted to write on any question on such papers at any future sitting.

3. Any candidate obtaining assistance, during the hours of examination, by copying the papers of another candidate, or otherwise, will at once be dismissed, and any candidate who shall permit such copying or give such assistance, will be considered equally guilty and treated similarly.

4. The candidate shall sign each sheet and mark on the top the number thereof and of the subject or group of subjects. He shall mark in the margin the number opposite each question, and shall attach the several sheets, together with the examination paper, to the cover provided for that purpose.

5. The candidate shall not write on one line more than one step in geometrical or algebraic work. A single step may cover several lines, but two or more should in no instance be put on the same line. They should be written thus:

Because $A = B$
And $B = C$
Therefore $A = C$

6. No other person than the examiners, the secretary and the candidates shall be admitted into the examination room unless by permission of the Board.

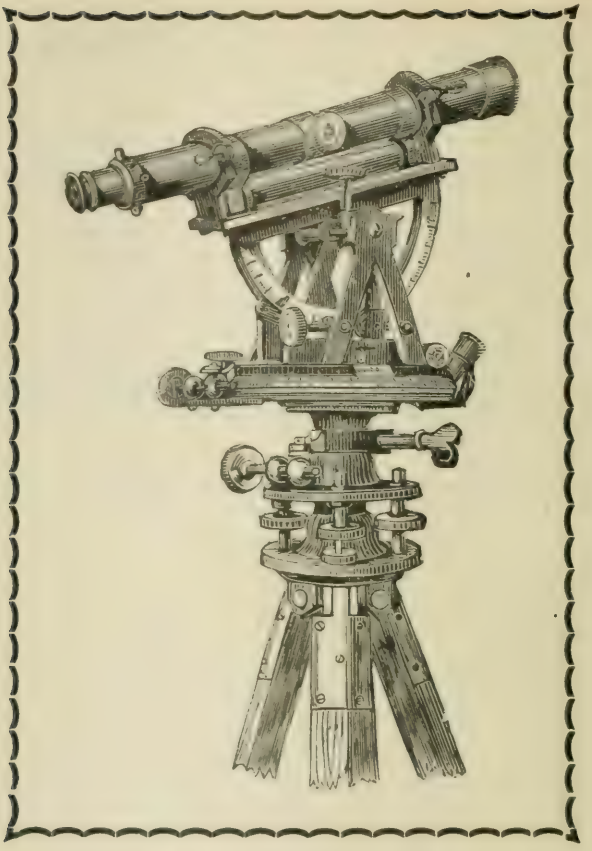
7. No books or diagrams of any kind, except those allowed by the Board, shall be brought into the examination room.

8. Candidates are to present themselves punctually at the hours appointed for the commencement of the examinations, and no candidates will be allowed to enter the examination room later than fifteen minutes after that time, nor will any candidate be permitted to leave the room during a sitting, but so soon as he has finished his papers he may hand them to the secretary, after which he will not be allowed to re-enter until the next sitting.

9. A candidate rejected by the Board shall not be entitled to a new examination before the next regular meeting of the Board.

10. Each candidate for "Admission to Practice" shall bring with him an instrument suitable for taking the necessary observations required in sec. (8), By-law 29, which he shall submit to the Board for their examination and approval, and he shall also submit a plan and field notes of a survey, both made by himself, which may be filed with his papers.

11. Each candidate for Admission to Apprenticeship shall bring with him a ruling pen and scale.



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No. 15.

ANNUAL REPORT

OF THE

ASSOCIATION

OF

Ontario Land Surveyors

ORGANIZED 1886. INCORPORATED 1892.

AND

PROCEEDINGS

AT THE

EIGHTH ANNUAL MEETING

SINCE INCORPORATION

HELD AT

TORONTO

27th and 28th February and 1st March, 1900.

PRINTED FOR THE ASSOCIATION BY
HENDERSON & CO., LOMBARD STREET,
TORONTO.

PATRONISE OUR ADVERTISERS.

NOTICES.

Members and others will be supplied with copies of the Annual Reports for 1886, 1887, 1888, 1889, 1891, 1892, 1893, 1894, 1895 1896, 1897, 1898, or 1899 upon remitting to the Secretary fifty cents, for each copy required.

Copies of the "Manual" may also be had from the Secretary. price fifty cents.

Each member of the Association is reminded of the fact that for the next Annual Meeting a good programme is most desirable, and to insure its preparation it is not now too early to bear the matter in mind.

In addition to its use as a library, the Repository now serves as a drafting room for members when copying Crown Lands plans and notes.

Published annually by the Association of Ontario Land Surveyors. Edition, 1350 copies; price, 50 cents.

PATRONISE OUR ADVERTISERS.

PREFACE.

To the Members of the Association of Ontario Land Surveyors :

The proceedings of the Association at its Eighth Annual Meeting are herewith presented.

On page 223 of this Report will be found the last additions to the "Manual" which may be removed without injury to the book and pasted into Manual thus keeping it up-to-date. Future additions will be published when necessary.

Your consideration of the advertisements appearing in our columns is requested.

Respectfully submitted on behalf of the Council,

VILLIERS SANKEY,

Secretary.

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ASSOCIATION OF
ONTARIO LAND SURVEYORS

(INCORPORATED 1892)

Organized 23rd February, 1886.

OFFICERS FOR 1900-1901.

PRESIDENT.

GEORGE ROSS, O.L.S., - - - - - - - Welland.

VICE-PRESIDENT.

JAMES DICKSON, O.L.S., - - - - - - Fenelon Falls

CHAIRMAN OF COUNCIL.

GEORGE B. KIRKPATRICK, O.L.S., - - - - - Toronto.

SECRETARY-TREASURER.

MAJOR VILLIERS SANKEY, O.L.S., - - - - - Toronto

MEMBERS OF COUNCIL.

HON. E. J. DAVIS, Commissioner of Crown Lands, - Toronto

A. J. VANNOSTRAND, Toronto.
W. R. AYLESWORTH, Belleville. — For Term ending April, 1903.

GEO. B. KIRKPATRICK, Toronto.
ALEX. NIVEN, Haliburton. — For Term ending April, 1902

J. L. MORRIS, Pembroke.
JOHN MCARCE, Rat Portage. — For Term ending April, 1901.

AUDITORS.

K. GAMBLE, - - - - - - - - - - Toronto.
H. J. BROWNE, - - - - - - - - - - Toronto.

BANKERS.

Imperial Bank of Canada (Yonge Street Branch), Toronto.

COMMITTEES, 1900-1901.

STANDING.

LAND SURVEYING.—Wm. R. Aylesworth (Chairman), J. D. Evans, Wm. Galbraith, M. Gaviller, H. H. Gibson, F. F. Miller, C. J. Murphy, A. L. Russell.

DRAINAGE.—A. S. Code (Chairman), J. A. Bell, F. W. Farncomb, F. W. Flater, T. H. Jones, W. G. McGeorge, Geo. Ross, G. Smith.

ENGINEERING.—M. J. Butler (Chairman), A. W. Campbell, J. Hutcheon, R. McDowall, A. J. McPherson, J. L. Morris, A. P. Walker, J. Warren.

ENTERTAINMENT.—H. L. Esten (Chairman), W. A. Browne, J. Dickson, H. DeQ. Sewell, T. B. Speight, A. P. Walker.

PUBLICATION.—K. Gamble (Chairman), H. J. Browne, H. L. Esten, W. A. McLean, A. J. VanNostrand.

TOPOGRAPHICAL SURVEY.—Otto J. Klotz (Chairman), M. J. Butler, W. Chipman, L. B. Stewart.

SPECIAL.

REPOSITORY AND BIOGRAPHY.—A. J. VanNostrand (Chairman), W. Chipman, R. P. Fairbairn, P. S. Gibson, T. H. Jones, G. B. Kirkpatrick, C. Unwin.

EXPLORATION.—L. B. Stewart (Chairman), G. B. Kirkpatrick, J. McAree, A. Niven, H. B. Proudfoot, H. W. Selby, G. E. Silvester.

PROGRAMME OF THE

Association of Ontario Land Surveyors

(INCORPORATED.)

AT ITS EIGHTH ANNUAL MEETING HELD IN TORONTO,

27th AND 28th FEBRUARY, 1st MARCH, 1900.

PROGRAMME.

Tuesday, 27th February—Morning at 10 o'clock.

AT THE REPOSITORY, PARLIAMENT BUILDINGS.

Meeting of Council.
Meeting of Standing and Special Committees
Call to Order, 11 a.m.
Report of Secretary-Treasurer.
Report of Committee on Repository and Biography. Willis Chipman, Chairman.
Paper—"Samples of a Country Surveyor's Life" H. H Gibson.
Paper—"Railway Curves" H. Strange.
Paper—"Railway Work." H. K. Wicksteed.

Afternoon at 2 o'clock.

President's Address.
Paper—"The Mining Outlook." T. R. Deacon.
Paper—"Mining Regulations (Yukon.)" T. Fawcett.
Paper—"A Survey under Sec 38, Survey Act, 1897." G. B. Kirkpatrick.
"Report of Committee on Land Surveying." H. H. Gibson.
Paper—"System of Survey." S. Bray.

Wednesday, 28th February—Morning at 10 o'clock.

Report of Committee on Publication. K. Gamble, Chairman
Paper—"Artesian Wells" A. J. McPherson.
Report of Drainage Committee. W. F. VanBuskirk, Chairman.
Paper—"Highway Culverts." A. W. Campbell.
Paper—"Bacterial Filter Beds for Sewage Disposal." E G. Barrow
Report of Engineering Committee. H. K. Wicksteed, Chairman

Afternoon at 2 o'clock.

Report of Committee on Exploration. M. Gaviller, Chairman.
Paper—"Blazed Trees." J. Davis.
Report of Council. V. Sankey, Chairman.
Report of Auditors. A. W. Campbell and H. L. Esten.
Paper—"Low Grade Ores." H DeQ. Sewell.
Paper—"The Yukon Country." E. D. Bolton.

Evening at 8 o'clock.

Paper—"Water Power." V. M. Roberts.
Paper—"Azimuth." C. Carroll.
Paper—"Azimuth from Polaris." Otto J. Klotz.
Paper—"Difficulties in Mining Laws" (Ontario) A J. Russell.

Thursday, 1st March—Morning at 10 o'clock.

Report of Committee on Entertainment. A. P. Walker, Chairman
Paper—"Original Survey" (Tp. Alfred.) E. T. Wilkie.
Paper—"The Forest Trees of Ontario." W. A. McLean.
Report of Topographical Survey Committee. Otto J. Klotz, Chairman.
Nomination of Officers—(President, Vice-President, Secretary-Treasurer, Auditors, two members of Council.)

Afternoon at 2 o'clock.

Ratification of By-Laws.
Unfinished Business.
New Business.
Adjournment.

Minutes of the Eighth Annual Meeting

OF THE

ASSOCIATION OF

ONTARIO LAND SURVEYORS

Held at the Repository, Parliament Buildings, Toronto,

on FEBRUARY 27th, 28th and MARCH 1st, 1900.

MORNING SESSION.

February 27th, 1900.

The eighth Annual Meeting opened at 10 o'clock a.m., the Vice-President, Mr. Ross, in the chair.

The Minutes of the previous meeting, as printed in the "Proceedings" for 1899, were taken as read, and on motion of Mr. Dickson, seconded by Mr. Kirkpatrick, were adopted.

Communications from Messrs. Schofield and Strange and the Engineers' Club were then read, and on the latter communication Messrs. Sankey and Butler spoke.

On motion of Mr. Sankey seconded by Mr. Niven, Messrs. Butler, Klotz and L. B. Stewart were appointed a Committee to bring before His Excellency the Governor-General the matter of topographical survey. Carried.

Mr. Sankey, Chairman of Council of Management, presented the Report of the Secretary-Treasurer and Financial Statement; and on motion of Mr. Sankey, seconded by Mr. Niven, the Financial Statement was submitted to the Auditors.

The President takes the chair.

The President then read a communication from Mr. Van Nostrand, resigning the position of Secretary-Treasurer of the Association.

The President—I have here a communication, gentlemen, which will probably be a surprise to the most of you. I think before we deal with it we will have to hear from the Secretary-Treasurer.

Mr. Van Nostrand—Mr. Chairman, I think the time has come, after ten years of one Secretary, for a change. I have been

very much interested in the work, and I have enjoyed it all through; but I find it takes up more of my time than under present circumstances I can afford to give, for I cannot do the Association work justice and attend to my own business, and I am afraid that the Association's business rather suffered last year on account of my own business being a little greater than it had been previously; I have, therefore, come to the conclusion that I must resign, and I think this is the best time to do so. We will have our nomination and election of officers presently, and, as a new Secretary will have to be appointed, it will be well for him to get into the traces as early as possible, the usual way is to appoint one pro tem.

The President—I certainly am very much taken by surprise by the Secretary's resignation, as I had hoped that he would continue to give the Association his services for many a year to come, perhaps it would be well for the Association to make it worth his while to continue as Secretary.

Mr. Van Nostrand—I trust that the members of the Association will not look at it in that light. The Association has dealt very generously with me. A great deal of the work that has been performed has been merely clerical work, and the Association should not pay more than clerical pay for it. Unfortunately I have professional work on hand which interferes with it. My resignation stands, and my thanks are due to the members of the Association for the way in which they have always treated me financially.

Mr. Sankey—Under the circumstances I would like to say a few words. Nobody in the whole Association knows what Mr. Van Nostrand has done for the Association as well as I do, and I cannot express to you what I feel at the loss the Association is sustaining. When Mr. Van Nostrand became our Secretary we were in our absolute infancy, and you see by his report this year the position we now stand in. We are in a strong financial position as well as in a strong professional position to-day, stronger, I think, than we have ever been in before. Personally I would be very glad if Mr. Van Nostrand would reconsider his decision. He told me privately of his decision some time ago. I urged him to reconsider it, and he said he would, but the reconsideration resulted in the same statement that he found that it was a matter between his professional duties and the Association, and under the circumstances the professional duties must prevail. I wish that someone's voice here would have more effect with

him than what I have said to him, or what others have said to induce him to remain with the Association as its Secretary, has had. You have heard what he has said; and I would like to bear testimony, as Chairman of the Council, to the very great value of Mr. Van Nostrand's services, and to express my very sincere regret at his finding it necessary to sever his present connection with us.

Mr. Niven—Mr. President, I am very sorry, indeed, that Mr. Van Nostrand has arrived at the conclusion that he can no longer hold the office of Secretary-Treasurer. We have been very fortunate in our Secretary-Treasurers. A number of years ago, when Mr. Chipman resigned, Mr. Van Nostrand was elected in his place, and I had hoped that he would have been our perpetual Secretary. However, as he seems to have made up his mind to give up the office, conflicting as it does with his professional duties, I do not think that we can press him to retain it. I do not like to move the acceptance of his resignation, hoping that something would turn up to keep him in office. I would suggest in the meantime that Captain Gamble be asked to assist him in his duties during this meeting.

Mr. Van Nostrand—It may be out of order for me to speak a third time on the same question; but I still think that someone should have the responsibility who is going to continue in the office. Although it is a matter for the Association to say when the time for election comes on, still they will be guided to some extent by what is done now; and if some one present can decide on some one who will probably take the position and hold it, that may affect the election to a certain extent. I do not think that the assistant arrangement will be workable. I shall be very glad to do what I can to assist the new Secretary, but I do not like to have the responsibility of doing his work altogether. I have considered the question of possible successors, and it struck me that possibly Captain Gamble or Major Sankey, or some one who has not got his time fully occupied by professional duties, might undertake it. I do not know what the sentiments of these gentlemen are; but I would be very glad to propose Mr. Sankey's name for the present in any event.

Mr. Ross—I take very great pleasure in seconding Mr. Sankey's name as the Secretary to succeed Mr. Van Nostrand. Mr. Sankey has been one of the fathers of the Association, and if he would take the position, I think he would be very acceptable to every member of the Association.

Mr. Dickson—Mr. President, from my first connection with the Association I have had very pleasant business and friendly connections with Mr. Van Nostrand, and it is with very great regret that I see he has made up his mind to sever his connection with the Association as its Secretary. I think I express the sentiments of every member here when I say that we universally regret that he has found it necessary to resign his position, and, although I do it very reluctantly, I beg leave to move that Mr. Van Nostrand's resignation be accepted.

Mr. Kirkpatrick—I will second that, but I do not like it at all. Like all the others, I looked forward to Mr. Van Nostrand being our Secretary; in fact I could not imagine him being anything else, because he is such a good-natured man that there is no possibility of anyone ever quarrelling with him—I do not think anyone ever did, and I am very sorry, indeed, that he has found it necessary to give up the position. At the same time I am glad to find that his business is looking up, so that he felt called upon to give up his whole time to his own work. It is a sign of the growing time we hear so much of, and I hope that it will be only an evidence of the growing time for the remainder of us surveyors. I suppose, as Mr. Van Nostrand has said that his determination is unalterable, the only thing for the Association to do is to accept his resignation with deep regret, expressing to him at the same time the deep sense of gratitude we all feel for the wonderful care which he has bestowed upon the interests of the Association, which as we all know, lie very much in the hands of the Secretary.

The President—Moved by Mr. Dickson, seconded by Mr. Kirkpatrick, that the resignation of the Secretary-Treasurer, Mr. A. J. Van Nostrand, be accepted with regret.

I am sure that we all feel that it goes against the grain to say "Aye" to this motion, but knowing the Secretary-Treasurer, we know that when he has made up his mind that a step is right he will stick to it, and it seems he considers this step necessary; so that with much regret I will have to ask you to signify your assent to this motion.

Mr. Kirkpatrick—Would it not be well to have an Acting Secretary appointed? Or is Mr. Van Nostrand going to continue as Secretary during this meeting? If not, I would move that Mr. Sankey be Acting Secretary, if he will kindly accept it.

Mr. Dickson—I second the motion.

Mr. Sankey—Mr. President, this matter is rather new to me.

but if you think it would be well for me to be Acting Secretary during this meeting, I will accept the position during the meeting, and until the Association has an opportunity of discussing what is really for its interests. I may say, as Chairman of the Council, that it is a matter of very great importance to this Association who takes Mr. Van Nostrand's place. The Chairman of the Council cannot do everything; he may assist, he may give advice, but it is the Secretary to whom the Association has to look practically for the carrying on of the business of the Association, and it is a matter, as I have said before, of very great importance who takes this office; it should not be just let go by chance; the duties have got to be considered, and the facilities for performing those duties have a great deal to say to their successful performance. In the meantime I shall be willing to act, knowing, as I do, that Mr. Van Nostrand will give me all the help he can.

Moved by Mr. Dickson, seconded by Mr. Kirkpatrick, that Mr. Van Nostrand's resignation be accepted. Carried.

Moved by Mr. Kirkpatrick, seconded by Mr. Dickson, that Mr. Sankey be Acting Secretary. Carried.

Moved by Mr. Dickson, seconded by Mr. Dickson, that this meeting now adjourn until 2 o'clock. Carried.

Afternoon Session.

The President, Mr. H. J. Bowman, in the chair.

The President announces receipt of telegram from Mr. T. H. Jones, regretting that he cannot attend.

A paper, "Railway Curves," by Mr. H. Strange, was read by Mr. L. B. Stewart.

Moved by Mr. Stewart, seconded by Mr. Kirkpatrick, that the paper by Mr. Strange be received and printed in the "Proceedings." Carried.

A paper, "Samples of a Country Surveyor's Life," by Mr. H. H. Gibson, was read by the writer. A short discussion took place upon this paper, after which it was, on motion, ordered that this paper be received and printed in the "Proceedings" of the Association.

The President then read his address, which was received with much applause, after which the President requested that the members present would discuss the propositions which he had made therein, upon which considerable discussion followed.

Paper, "Mining Regulations (Yukon)," was read by Mr. Fawcett, writer of same. After discussion thereon the paper was, on motion, received and ordered to be published.

Paper by Mr. Kirkpatrick, "A Survey under Sec. 38, Survey Act, 1897," was read by him, and on motion of Mr. Sewell, seconded by Mr. Niven, the paper was received as read, and ordered to be printed in the "Proceedings."

On motion it was decided to postpone the reading of Mr. T. R. Deacon's paper "The Mining Outlook," until to-morrow morning.

The meeting then adjourned at 6 o'clock until to-morrow morning, as the annual dinner of the Association took the place of an evening session.

Morning Session.

Tuesday morning, Feb. 27, 1900.

Meeting called to order at 10 o'clock by Mr. Ross.

Paper by Mr. T. R. Deacon, "The Mining Outlook," read by Mr. Van Nostrand.

It was moved by Mr. Van Nostrand, seconded by Mr. H. H. Gibson, that Mr. Deacon's paper on "The Mining Outlook" in Western Ontario be received and printed in the "Proceedings." Carried.

Report of Committee on "Land Surveying" was then read; and on motion of Mr. H. H. Gibson, seconded by Mr. Niven, the Report was received and adopted.

Afternoon Session.

The President in the chair.

Paper, "Blazed Trees," was read by Mr. Davis; and after discussion, on motion of Mr. Niven, seconded by Mr. H. H. Gibson, that Mr. Davis' paper be received and printed in the Minutes, and that a vote of thanks be rendered to Mr. Davis. Carried.

Mr. D. De Q. Sewell's paper on "Low Grade Ores" was then read and discussed; and on motion Mr. Sewells' paper was received, and ordered to be printed in the "Proceedings."

The paper on "Artesian Wells," prepared by Mr. A. J. McPherson, was read by Mr. H. H. Gibson; and after a very lengthy discussion it was resolved, on motion, that this paper be received and printed in the "Proceedings."

The paper prepared by Mr. E. G. Barrow on "Bacterial Filter Beds for Sewage Disposal," was read by Mr. A. J. Van Nostrand, and on motion the same was received and ordered to be printed in the "Proceedings."

The Report of the Council of Management was read by Mr. Villiers Sankey. With the Report he also presented the Report of the Board of Examiners.

It was moved by Mr. Dickson, seconded by Mr. Watson, that By-laws Nos. 1-46, as printed in the Annual Report for 1899, and the Rules for the Board of Examiners be hereby ratified, and the motion carried.

Mr. Villiers Sankey moved the adoption of the Report of the Council of Management, seconded by Mr. Niven and carried.

Paper, "The Yukon Country," was then read by Mr. E. D. Bolton; and on motion of Mr. P. S. Gibson, seconded by Mr. Wilkie, the paper was received and ordered to be printed in the "Proceedings."

Evening Session.

The Vice-President, Mr. Ross, in the chair.

Paper on "System of Survey," written by Mr. S. Bray, was read by Mr. W. H. J. Wilkie.

It was moved by Mr. Van Nostrand, seconded by Mr. E. D. Bolton, that Mr. Bray's paper be received and printed in the Proceedings. Carried.

Paper, "Highway Culverts," prepared by Mr. A. W. Campbell, was then read by Mr. A. J. Van Nostrand, and after discussion it was moved by Mr. Niven, seconded by Mr. Wilkie, that Mr. Campbell's paper be received and printed in the Proceedings. Carried.

Mr. C. Carroll's paper on "Azimuth" was read by Mr. L. B. Stewart, and discussed; and on motion of Mr. Niven, seconded by Mr. Speight, the paper was received and ordered to be printed in the Proceedings; and the thanks of the Association

were rendered to Mr. Carroll and Mr. Stewart for the paper and the explanations.

Paper on "Water Power," by Mr. Roberts, was read by Mr. Van Nostrand and discussed.

It was moved by Mr. Niven, seconded by Mr. Speight, that the paper be received and printed in the Proceedings.

The meeting adjourned at 10 o'clock until 10 o'clock to-morrow morning.

Morning Session.

February 28th, 1900.

The President called the meeting to order at 10 o'clock.

Paper, "Azimuth from Polaris," which was prepared by Mr. Otto J. Klotz, was read by Mr. Stewart. It was moved by Mr. Dickson, and seconded by Mr. Ross, that a vote of thanks be sent to Mr. Klotz for his valuable paper, and that the same be received and printed in the "Proceedings."

The following communication on "Magnetic Declination," by Mr. Otto J. Klotz, was read by the President; and on motion by Mr. H. H. Gibson, seconded by Mr. Van Nostrand, it was resolved that the matter of collecting data on magnetic declination be referred to the Land Surveying Committee to take action thereon during the coming year:

The time has arrived for the systematic compilation of all magnetic data in Canada. Apart from its great scientific value in the study of terrestrial magnetism, the subject has a very important practical bearing, too, as nearly all the original surveys in the older Provinces of the Dominion were made with the compass. Due to the secular variation in the magnetic declination, the bearing of many of the old lines run differs now widely from the original one. The knowledge of this change or variation is of great importance in retracing boundaries of properties. By means of a large collection of magnetic data we will also be able to discover deflections of the needle due to local disturbances, and thereby adjust apparent anomalies. The scope of this work naturally falls within the sphere of the Dominion.

Besides obtaining from the various Provincial Crown Lands offices the available data from the old records and surveys, it is intended to solicit the co-operation of every surveyor throughout Canada by getting any data that he may have pertaining to

magnetic declination, or 'variation,' as popularly known. For that purpose blank forms will be supplied.'

DISCUSSION.

Mr. Van Nostrand—I suppose that is intended to take effect in the Association, and that the Association will furnish blank forms. There is no doubt that there should be a compilation of data regarding magnetic declination. Mr. Kirkpatrick referred to it in his paper. There is great dearth of that sort of information in Canada. We have to go to the other side of the line, and make a sort of estimate as to how our declination should bear on different points in the United States. And this Association ought to try to give all the assistance it can in the collection of data.

The President—This communication had better be referred to the Land Surveying Committee, or some action be taken in collecting data?

Mr. Gibson—I think it ought to go to the Secretary.

The President—If anything is to be done it is hardly fair to leave it to the Secretary alone to take action.

Mr. H. H. Gibson—I would make a motion that this matter be referred to the Land Surveying Committee. If they have something definite in hand they will probably take a little more time to it.

Mr. Ross—I will second that.

Mr. Kirkpatrick—Before going on to the next paper I would ask the Association to suspend the Rules of Order for a minute until I introduce a resolution to have placed on record when there is a full house, not to wait until this afternoon, when, perhaps, there will not be so many present.

Mr. Kirkpatrick—Mr. President, we are all aware that in the wisdom of the Governor-General and the Dominion Cabinet a member of our Association has been lately called to the high dignity of a member of the Senate of the Dominion of Canada; and I thought it would be a graceful act to place on record our sense of the appreciation of the honor done, not only to that gentleman himself, but also to the Association of Ontario Land Surveyors, of which he is a valued member. We had the pleasure of having him at our annual dinner the other night; and what gave us a peculiar pleasure in his presence on that evening was this, that although not a British Canadian, but a French

Canadian, his utterances that evening showed conclusively that he believed there is no difference between the English Canadian, the Scotch Canadian, the Irish Canadian and the French Canadian, but that they are all united in their attachment to the liberty which they enjoy under the British Constitution. I allude to our friend, the Hon. J. P. B. Casgrain, member of the Senate of the Dominion of Canada; the resolution I have just drawn up—I am not accurate as to the phraseology, but I just drew it up as the words came into my mind. (Reads.)

Mr. Niven—I have much pleasure in seconding that motion, Mr. President. Mr. Casgrain was an active member of this Association at one time. He has not been so of late years, but he gave us quite a lift in getting our Act of Incorporation. The Society of Land Surveyors in Quebec had incorporation before we had, and Mr. Casgrain's assistance was valuable at that time.

Moved by Mr. Van Nostrand, seconded by Mr. Dickson, that the Rule of Order be suspended in order to permit Mr. Kirkpatrick to bring in a resolution. Carried.

Mr. Kirkpatrick then moved the following resolution, seconded by Mr. Niven, which was carried unanimously:

"That the members of the Association of Ontario Land Surveyors, assembled at the Annual Meeting in February, 1900, desire to place on record their hearty congratulations to a valued member of their Association on his being appointed to the honorable position of a member of the Senate of Canada, and to express to their confrere, the Hon. J. P. B. Casgrain, their warmest wishes for his future welfare in the legislative halls of the Dominion of Canada, and to assure him that they view his elevation to the Senate with peculiar pride and satisfaction. Carried.

Paper, "Difficulties in Mining Laws in Ontario," or, as the writer has termed it, "Some Puzzles in Our Mining Laws," written by Mr. A. L. Russell, was read by Mr. Van Nostrand; and on motion the paper was received and ordered to be printed in the "Proceedings."

The meeting adjourned at 1.20 until 2 o'clock.

AFTERNOON SESSION.

The President in the chair.

The Report of the Committee on "Topographical Survey" was read, and on motion of Mr. Niven, seconded by Mr. P. S. Gibson, the Report was received and adopted.

Report of Publication Committee read.

Moved by Capt. Gamble, seconded by Mr. Speight, that the Report of the Publication Committee be received and adopted. Carried.

Report of the Exploration Committee read.

It was moved by Mr. P. S. Gibson, seconded by Mr. Niven, that the Report of the Exploration Committee be received and adopted. Carried.

Moved by Mr. H. H. Gibson, seconded by Mr. Roger, that the paper by Mr. W. A. MacLean, "The Forest Trees of Ontario," be taken as read and printed in the "Proceedings," and the thanks of the Association be rendered to Mr. MacLean for his work in its preparation. Carried.

Paper, "Original Survey" (Township of Alfred), was then read; and it was moved by Mr. Dickson, seconded by Mr. Kirkpatrick, that a hearty vote of thanks be tendered to Mr. Wilkie for his paper, and that it be printed in the "Proceedings." Carried.

Report of the Drainage Committee was then read by Mr. W. F. Van Buskirk; and on motion of Mr. Dickson, seconded by Mr. H. H. Gibson, it was resolved that the Report of the Drainage Committee be received and adopted.

Moved by Mr. Van Nostrand, seconded by Mr. Van Buskirk, that the paper on "Railway Work" by Mr. H. K. Wicksteed be taken as read and printed in the "Proceedings." Carried.

Moved by Mr. Ross, seconded by Mr. Rogers, that the Report on the Committee of Entertainment be taken as read and printed in the "Proceedings." Carried.

Moved by Mr. Dickson, seconded by Mr. Shaw, that the Report of the Committee on "Engineering" be taken as read and printed in the "Proceedings." Carried.

The President announced that in the absence of Mr. Chipman there is no Report as yet of the Committee on "Repository and Biography," but no doubt it will be forthcoming.

Moved by Captain Gamble, seconded by Mr. Ross, that the Report of the Committee on "Repository and Biography" be taken as read and printed in the "Proceedings." Carried.

NOMINATION OF OFFICERS:

PRESIDENT.

Moved by Mr. Dickson, seconded by Mr. Niven, that Mr. George Ross be President of the Association for the coming year. Carried.

VICE-PRESIDENT.

Moved by Mr. Ross, seconded by Mr. P. S. Gibson, that Mr. Dickson be Vice-President for the coming year. Carried.

SECRETARY-TREASURER.

Moved by Mr. P. S. Gibson, seconded by Mr. Niven, that Mr. Villiers Sankey be Secretary-Treasurer. Carried.

AUDITORS.

Moved by Mr. Niven, seconded by Mr. Ross, that Captain Gamble be one of the auditors. Carried.

Moved by Mr. Speight, seconded by Mr. Watson, that Mr. Harry Browne be one of the auditors for the coming year. Carried.

MEMBERS OF COUNCIL.

The following are nominated as members of the Council: Messrs. W. F. Van Buskirk, A. J. Van Nostrand, E. T. Wilkie, W. R. Aylesworth, J. W. Tyrrell, H. H. Gibson, A. S. Code, and John McAree.

SCRUTINEERS.

The following gentlemen are appointed as scrutineers for the ballots: Messrs. Speight and Whitson.

It was moved by Mr. Kirkpatrick, seconded by Mr. Dickson, and resolved: "That the sum of $200 be granted to the Secretary-Treasurer as a slight remuneration for his services. Carried.

Moved by Mr. Niven, and seconded by Mr. P. S. Gibson, and resolved: "That we have learned with regret of the removal by death of Jos. Green Kirk since our last meeting of members." Carried.

Moved by Mr. H. H. Gibson, seconded by Mr. Dickson, that any omissions or clerical errors in the records of this meeting, now in the hands of the Acting Secretary and Stenographer, be corrected by the Committee on Publication before being printed. Carried.

Moved by Mr. Kirkpatrick, seconded by Mr. Wilkie, that the auditors be paid the sum of $5 each for their work auditing the accounts of the past year. Carried.

Moved by Mr. P. S. Gibson, and seconded by Mr. Wilkie, that the President do leave the chair, and that a hearty vote of thanks be tendered to our retiring President for the very able and efficient manner in which he has discharged the onerous duties devolving upon him.

Mr. Bowman thanked the members of the Association for their hearty vote of thanks, and expressed the great pride it had been to him to fill the office of President, and expressed the hope that as years go on all the members will be able to gather annually, and help each other along in the work necessary to keep us abreast of the times in our profession.

On motion of Mr. Dickson, seconded by Mr. P. G. Gibson, at 4 o'clock p.m. the meeting adjourned with the singing of the National Anthem.

MEMBERS IN ATTENDANCE AT THE EIGHTH ANNUAL MEETING.

27TH, 28TH FEBRUARY AND 1ST MARCH, 1900.

W. R. Aylsworth.
H. J. Bowman.
E. D. Bolton.
L. Bolton.
G. L. Brown.
E. Bazett.
M. J. Butler.
J. P. B. Casgrain.
A. W. Campbell.
J. Dickson.
John Davis.
H. L. Esten.
R. P. Fairbairn.
T. Fawcett.
W. B. Ford.
K. Gamble.
H. H. Gibson.
P. S. Gibson.
J. Galbraith.
J. Hutcheon.
G. B. Kirkpatrick.
W. A. MacLean.
C. J. Murphy.
J. J. Mackay.
A. Niven.
Geo. Ross.
John Roger.
F. J. Robinson.
T. B. Speight.
J. H. Shaw.
L. B. Stewart.
V. Sankey.
Angus Smith.
Wm. Spry.
Henry Smith.
H. DeQ. Sewell.
G. E. Silvester.
C. Unwin.
A. J. VanNostrand.
W. F. VanBuskirk.
E. T. Wilkie.
J. F. Whitson.
A. P. Walker.
M. B. Weekes.
J. N. Wallace.

RESULT OF ELECTIONS FOR 1900-1901.

President.....George Ross .....(by acclamation).
Vice-President.....James Dickson .....(by acclamation).
Secretary-Treasurer.....Villiers Sankey.....(by acclamation).

Members of the council of Management elected for the ensuing three years :

A. J. Van Nostrand. J. W. Tyrrell.

Auditors for the ensuing year : (by acclamation).

Harry J. Browne. Killaly Gamble.

I hereby declare the above named officers elected.

VILLIERS SANKEY,
Secretary-Treasurer.

Certified correct.

T. B. SPEIGHT, }
J. F. WHITSON, } *Scrutineers of Ballots.*

Under Sec. 16, Chap. 180, R.S.O., 1897 the Council appointed Mr. John McAree to fill the vacancy caused by the resignation of Mr. Jas. Dickson as member of the Council.—*Secretary*

PRESIDENT'S ADDRESS.

Gentlemen,—It is very gratifying to find that a good programme has again been prepared for our Annual Meeting, the fifteenth in the history of the Association and the eighth since incorporation. It is to be hoped there will be time for full discussion of the different reports and papers. A tendency towards a smaller number of papers need not be feared, as in that event more time may be devoted to the consideration of them and the exchange of experiences between the members, which is often more helpful than the papers themselves.

No doubt many of you have noted with interest the propositions of the new leader of the Ontario Government, particularly in reference to the appropriation of $40,000 or $50,000 for preliminary exploration work in the northern part of the Province up to the shores of Hudson Bay for the purpose of obtaining information as to its timber, mines and arable lands; and also his announcement that it is hoped a system may be projected whereby the three million acres of swamp lands in the

Province may be properly drained. A great aid to this latter project would be the carrying out of the much-needed topographical survey of the older part of the Province. In the old County of Waterloo there is a township that has several very large swamps or marshes in it, one of them about a thousand acres in extent, and steps would doubtless have been taken long ago to drain them were there maps in existence showing the topography of the district, the location and elevation of the different ponds, streams and ridges. As a matter of fact there is no plan on file anywhere showing even the lots as originally surveyed in this particular township. As most of these large swamps in this township have no natural outlet, nothing can be done in the way of drainage till a topographical survey is made.

Recently an agitation has arisen for provincial aid for highway construction. As subsidies have long been given to railways, there cannot be any difference in principle in granting aid to establish good macadamized roads as feeders to these railways; and, as provincial subsidies are now very seldom granted to railways in the older part of the Province, it would seem only fair that some plan should be devised for thus continuing the development of the country. In the State of Massachusetts, where the principle of State aid has been adopted, the writer was recently informed by one of the Commissioners that already the large sum of $2,600,000 has been expended in building first-class macadam roads.

A few of our members, who are also members of the Canadian Society of Civil Engineers, accompanied the excursion a month ago to Boston. The experience gained on a trip of this kind, the pleasant intercourse with the other members of the party, and the consequent broadening of the individual thought, suggest the consideration of the advisability of a somewhat similar excursion at some future date for the benefit of our own members. No doubt the members resident at or near our national capital, as well as some of our other larger cities, would be glad to have the Association visit them, and would prepare papers dealing with local matters of general interest.

The proposed Engineers' Bill was amended last year to meet the views of your Committee appointed in that behalf, but it is not likely that it will come up at this Session of the Legislature.

As the Association has now an unquestioned surplus, would it not be well to authorize the Council to purchase for active members 50 or 100 feet steel standards of measurement, and have

them stamped by the Dominion authorities. For such a large number a close figure would be quoted by the different manufacturers. Some of our funds could advantageously be used in enlarging and fitting up the new repository. By the use of Luxfer prisms the light could be much improved, and by removing some of the partitions and putting in a wooden floor on top of the concrete a room would be obtained more suitable for the meetings of this august body.

In conclusion, it will be only necessary to make a passing reference to the war now being waged in that distant part of the great empire, of which we are proud to form another part. This unhappy occurrence has shown to the world the great bond of unity which exists between Great Britain and her colonies, as evidenced by the spontaneity with which the people of the colonies have, unsolicited, sent their sons to help the Mother Country in giving to the people of South Africa that freedom which we enjoy. It will be for you to decide whether a fitting donation shall be made to the fund established for the relief of those dependent upon our brave boys who have fallen at the front.

HERBERT J. BOWMAN,
President.

February 27, 1900.

DISCUSSION.

Mr. President—I shall be glad if the gentlemen present will discuss some of the propositions that I have made.

Mr. Sankey—Mr. President, I was going to remark on hearing your address there was so much in it to discuss that it would be well for the different points to be taken up separately and discussed. In some Associations, I believe, it is the custom to refer an address of this kind to a special committee in order to promote a general discussion; but as that would be rather out of the way here I would suggest that each point be taken up in its order as mentioned in the address, and discussed to a finish.

Mr. Dickson—Would you read the address clause by clause?

The President—The new leader of the Government, Mr. Ross, in a speech which, I think, he made at Whitby, mentioned that he intended to ask for $40,000 or $50,000 for exploration work in the northern part of the province. I think that was referred to before in one of the other reports. Perhaps some of our members are in the confidence of the Government.

Mr. Dickson—Perhaps Mr. Kirkpatrick would not mind letting us know what the system is, under which this will be done, if he is at liberty to do so; his information would be of interest.

The President—It was not clear whether this was to be all spent in one year or not.

Mr. Sankey—Assume the money is going to be spent, and let us have the various opinions as to the best way to spend it.

Mr. Dickson—I think if the Government is asking for this grant their intention is to spend it this year.

Mr. Sankey—Are they going to ask our advice?

Mr. P. S. Gibson—They will no doubt ask our advice as to the spending of it.

The President—It is taken for granted that the exploration would have to be made by Ontario land surveyors.

Mr. P. S. Gibson—Of what character is this exploration work to be—for mining or agricultural purposes?

The President—They wish to find out the nature of the country. I should not think they refer to timber.

Mr. Sankey—Both Mr. Niven and Mr. Speight have more experience in our northern country than any one else, and they should know what is the best method of spending the money; that is, getting the most value for the money spent.

Mr. Niven—Well, Mr. President and gentlemen, I do not usually suggest anything; I do what I am told to do. Of course, I have heard something of the exploration, but I have no idea as to what way they intend to do it. I have not given the matter sufficient thought to suggest to-day before this body of surveyors or anyone else what should be done. But I believe that a system of exploration could only be properly conducted between base and meridian lines; and it would be necessary to cut the country up to some extent into certain sized districts, and then the exploration could be made between the district boundaries, because if you send a number of surveyors or others into a country like ours to go through and tell what is in it, they could never know where they were—they would be lost for the time, and, although they might make calculations about their latitude and longitude they would be very much out.

Mr. P. S. Gibson—Don't you think the compass survey would be very much better than these transit surveys to get over the country?

Mr. Niven—With the transit, of course, it takes longer to do it, but you know what you are doing, and when it is done you have something definite.

Mr. Sankey—But with the expense attendant on the running of the base line, isn't the actual exploring overlooked? That is, the thorough understanding of the country seems to me to be overlooked on account of the expense necessary to run the base line.

Mr. Niven—So it is in the way it has been done, because the surveyor cannot leave the line; he is there attending to his work; but in some instances we have had explorers attached to a party whose business it was to go perhaps six miles on each side. Well, sometimes they would go six miles, but very often they would not go so far; it might happen that they thought they had gone six miles when they were only four miles. But it appears to me that if the country were cut up into districts, and then exploration parties put in to explore from one boundary to the other, that you would certainly get a better idea of the country than in any other way.

Mr. Sankey—With regard to these base lines, is it worth while going to the expense of running an expensive transit line through a country you know nothing about? You may start this transit line from a practically useful point, but the line may lead you you don't know where. Therefore the expensive line is more likely to be run in the wrong place than the right. Would it not be well to lay out the country with compass lines first. As Mr. Niven truly remarks, you may not know exactly where you are, but still I think a general knowledge of the country would be acquired, and then the base lines could be run in useful locations.

Mr. Kirkpatrick—I have had a little experience in this kind of work. I had a plan given to me some years ago by the Government. My method of doing this work is to have not only a surveyor with me, but also two or three young fellows, and when you get on to a real nice country, then you can run your meridian lines or governing lines, and run them well, too.

Mr. Dickson—I think what is worth doing at all is worth doing well. We do not know what is in the country. We can go over it, and find out what is on the surface, but we do not know what is underneath it. The ground may be full of minerals, and we may make our compass surveys and establish certain points, and then the true surveys have to be made where the

mineral locations are found, and then whatever is to be done should be done in a very thorough manner. I believe in a line being well staked out and blazed with properly marked posts, and then there is no further expense necessary to pick up your lines. I would certainly suggest properly run meridian lines in every instance.

Mr. Kirkpatrick—Of course, I do not know what the Premier will do; but I was asked some time ago by him to prepare a scheme. Well, the first thing to do is to prepare a map. As far as the Rainy River district is concerned I always had a good deal of trouble in early days to get the Commissioner to authorize the running of base and meridian lines with permanent monuments. They were generally afraid that the expenditure could not be defended in Parliament as readily as money expended in subdividing townships into farm lots. I always maintained, however, that if necessary I would go before any committee and justify such expenditure as the best money that ever was spent in the Province of Ontario. I am not required now to go before any committee—the event has justified the action. The Government have gained, I suppose, $50 for every dollar that was spent in running those base and meridian lines. Now, the consequence is that we had base and meridian lines within reasonable distance of each other by the time they were required. This last year there was very nearly $100,000 taken in through my branch alone by the sale of mining lands. I very much question if the cost of running base and meridian lines was anything like that amount. Now, as regards the newer part of the province; that is, the part lying in the Districts of Algoma and Nipissing. Of course, there is really very little known of that, but sufficient is known to expect that there is a very large extent of arable land, as well as a very large extent of territory covered by spruce, which is now probably the largest extent of spruce on this continent. We know exactly what is being done in the way of pulp manufacturing. And as the land is cleared up it will be found from surveys made by Mr. Niven and others that the soil is suitable for agriculture, probably to a very large extent. Now, my idea is that a combination of base, meridian and exploratory lines can be done every year, and I know that such work will not be thrown away. My idea would be to run a base line through the centre of the known good land. I would also probably explore with cheap compass lines—I do not say that I would necessarily run them north or south, or anything like that; but I would have them go through the spruce swamps. Of course, you all know

that the rivers flow into the sea through that country, and there is an enormous number of them to map out the country. As well as I could, I have estimated at what cost I thought this could be done for, but I do not believe systematic knowledge of the country could be obtained quickly, but certainly a good general knowledge can be got. I do not think it will be possible, of course, to arrive all at once at an exhaustive knowledge of what the country contains, but I confidently expect that the expenditure of $40,000 or $50,000 will bring in a large amount of information, which is much required concerning the northern part of the country. I think it will be quite evident to everybody that explorers will have to go with each survey party, also probably a geologist, and perhaps in the thickly-wooded part experts in timber, so as to be able to value and estimate the amount of timber. A great many survey parties have good line-runners, but they may not have much idea of the value of the timber. Of course, it is an expert's work, and I think myself that probably a good timber valuator or estimater accompanying each party will not be money thrown away. We may as well get out of the idea that a surveyor can do everything. In parties like these every man will have to use his brains. Not some kind of a line, but a combination of lines, I think, will bring in a large stock of information; that is what I confidently hope and expect.

The President—There has been an agitation for provincial aid towards higher construction of roads. Last fall there was a convention in Toronto of representatives of different municipalities, at which this matter was very fully discussed; and we may look for some legislation on the subject, as no doubt some system can be put into our road building. In some parts of the province it is not looked upon with very great favor because they have good roads; but the method recommended seems to be to have the counties assume leading highways through the county and improve them, the Government giving a grant to aid them in this direction. This method is pursued in some of the States across the line. As I stated in my address, the State of Massachusetts is in the lead. Under this system of State aid they have spent during the last few years $2,600,000 on good macadam roads. The centre of the road is macadamized.

Mr. Aylesworth—For a width of fifteen feet they are macadamized; then the sides are gravelled and proper ditches made. In my county the county roads are under a superintendent, who has three, four or five gangs of men as may be necessary kept

in various parts of the county working during the summer season. We also have a bridge gang. We have over 275 bridges kept up by the county. We spend from $12,000 to $15,000 annually on our bridges. Our bridges are now in first-class condition, and are built of iron or wood.

The President—The next matter I touched upon was the trip of the Canadian Society of Civil Engineers to Boston. About a month ago I suggested the advisability of our Association taking a similar excursion to perhaps Ottawa or some of the other large cities in the province or Montreal Then I mentioned that the Engineers' Bill was amended to suit our Committee last year, but no progress was made in the Legislature with it. I believe the chairman of the Committee, Mr. Chipman, is at present in Europe, so it is not likely that the matter will come up this Session.

The next matter I suggest is to use some of our surplus in the purchase of steel standards of measurement. We have already got those little wooden affairs which are given to those who pass the final examination. What we need is a reliable standard which we can take into court, as a standard of measurement, and if a couple of hundred were bought at one time it could be done very expeditiously and very cheaply, and no doubt arrangements could be made with the Weights and Measures Department at Ottawa to stamp them all at the same time.

Mr. Sankey—When the present Board of Examiners came into office we found there was about half a gross of the old wooden standards in existence. They were not stamped. Well, we thought that such good old timber as that (I understand good seasoned timber is rather expensive now-a-days), was too good to be thrown away. However, you will be happy to know that the last of those old sticks has gone. We are to-day in communication with the manufacturers as to a suitable standard. The suggestion that the Board of Examiners made was that a thirty-three-foot steel tape line be graduated in feet on one side and links on the other, the first foot to be graduated into inches and sixteenths and the last foot to be graduated into tenths and hundredths, the first ten links to be graduated into individual links, as a suitable standard for Ontario Land Surveyors. Then a sixty-six foot tape or a 100 foot tape could be easily compared with such a standard. One of the strong objections to having a thirty-three foot tape is that it is not very much good to take out in the bush or in the country. Under

the Statutes a surveyor is supposed to take the standard supplied him by the Board of Examiners to compare his chains with.

Mr. P. S. Gibson—We are bound to have our chains stamped.

Mr. Sankey—We are bound to be in possession of the standard that is given by the Board of Examiners, and we are supposed to have sufficient knowledge to compare the other chains we use. What I want to know is whether the 33-foot steel tape, which is not of a very expensive character, graduated as I have mentioned, will be in the opinion of all present a suitable standard to have. The candidates for examination, when they pass their final examinations, have hitherto been charged $2 apiece for the wooden standards I have no doubt they would be willing to pay a little extra if they got a better standard. At the present time the funds of the Association might be drawn upon to a certain extent. Surveyors who have been in practice for some time would pay $3.50 or $4 for a tape such as I speak of.

Mr. P. S. Gibson—Mr. Sankey's views meet mine exactly.

The President—I think that a 100-foot tape would be perhaps a more satisfactory standard, because you could compare the 100-foot, 66 foot and 33-foot chains directly with this.

Mr. P. S. Gibson—I would suggest this: that there should be different lengths for standards, and those who want a 100-foot one should pay a little more.

The President—I think every member should have a standard tape, either to be furnished gratis or upon a small payment; a 100-foot tape would be the most satisfactory. A portion of the tape might be divided in the metric system, as some time in the future the metric system may be adopted, and we might just as well have the graduations in these standards; and if they are properly taken care of they will last forever.

Mr. Sankey—As to price, I am reading now from the Lufkin Rule Company price list. Their price for a 25-foot tape, marked in feet and tenths and hundredths, with a substantial case and everything perfectly suitable for doing actual work, is $4.50. The price for a similar tape 100 feet long is $12.80. The 50-foot tape is $7.20. I have one of these tapes myself, and it is a most beautiful tape. I did not go to the expense of having it nickel-plated, though they nickel-plate them for $1.50 more. I have used it two years, and it has given me great satisfaction. It is a very easily-cleaned tape. The material it is made of is not easily rusted, and it is very easily brightened. It does not kink very quickly. I think the diameter of the box is 3 3-4 or 4 inches.

Mr. P. S. Gibson—What is the breadth of it.

Mr. Sankey—It is probably about five-eighths inch.

The President—Of course, our standards need not be used for measurement, but for comparison. A narrow tape is less apt to be broken by being stepped upon. I should think that by giving a special order for a couple of hundred of 100-foot tapes they could be got for about $5 apiece, and if we got the Dominion Government to obtain them for us we would not have to pay any duty; they could be made in England. Most of the best tapes are made in England, and afterwards sold by our American cousins as their tapes.

Mr. Sankey—I would like to know for the Council and for the Board of Examiners what the Association desires to do in this matter. We may go and buy a 33-foot tape, and no one will want to buy it from us.

Mr. P. S. Gibson—Order a variety of lengths.

Mr. Sankey—That would not answer, Mr. Gibson. Whatever standard is going to be established must be officially established, and every surveyor should be in possession of the official standard.

Mr. Aylesworth—I think it would be much better to have a standard of about 33 feet. I move that this Association recommend a 33-foot standard.

Mr. Ross—I beg to second Mr. Aylesworth's resolution. I think the standard should be of the same material as the tapes we use; the standard will be correct up to a certain temperature.

The President—It has been moved by Mr. Aylesworth, seconded by Mr. Ross, that the Board of Examiners be recommended to adopt a 33-foot steel tape as the standard of measurement to be given in future to those who pass the final examination. They might purchase a sufficient number to allow the older members to get them at a nominal figure. I hope that they will be able to do so.

Mr. Wilkie—For myself I should be very glad to purchase one, and I think with Mr. Sankey that the 33-foot would be the most suitable. I do not anticipate any trouble in comparing the length of my 100-foot chain with the 33-foot standard.

The President—Probably the Council will issue a special circular after they ascertain what the cost of the different lengths would be, and after they find out about testing by the Weights and Measures Department, and then find out how many would be required. The motion was carried.

The President—The only other matter I mentioned was with

reference to the war that is now being waged in South Africa, to draw your attention to the fact that it would be a very good idea, I think, to make a small grant towards the Patriotic Fund. I would suggest that we give $100. We have practically a cash balance on hand of $2,000, so that we do not have to consider very long whether we can stand a small grant or not.

Mr. Dickson—I think we can stand it very well.

Mr. Van Nostrand—We have one or two accounts that will be due. I do not know what the printing of our manual will be—it was to be here to-day, but it has not arrived yet—but that will be a fairly large item. Then we have the standards to consider, and the new rooms that we are about to have given to us on the other side of the corridor will be partially fitted up by the Government for our use; but it was intended that we should have some elaborate fittings of our own, which would run into a certain amount of money. The surplus last year increased about $300; in the previous year there was scarcely any increase; it is not a regular increment at all, and last year's record was considerably out of the ordinary. Part of it was due to the fact that moneys due to the Association had not been collected the year before, and they came in last year, so that we cannot look for any similar experience. I do not think that an average of more than $100 a year can be counted on, with our present running expenses, for increasing our surplus. It has been suggested that when the surplus got large enough we should carry on any litigation which we may be brought into in view of some matters that are now before the Council; it was proposed also that after our surplus had come to a substantial sum the annual dues would be reduced to $1. There are members who think $4 too much. Proposed by Mr. Aylesworth and seconded by Mr. Dickson, that $100 be given to the Patriotic Fund. Motion carried.

The President—I would suggest that the cheque be made payable to Sir Oliver Mowat. He is the President for Ontario, and it would be very nice to have his autograph on the back of our cheque, and probably in the future it would be a relic that we would prize.

The President—Mr. Blue, of the Bureau of Mines, has just conveyed to me the intelligence that the Commissioner of Crown Lands would be glad if we would take an upper chamber and go up higher. We can have the use of the Railway Committee Room for the rest of the afternoon.

REPORT OF THE COUNCIL OF MANAGEMENT FOR THE YEAR 1899.

Mr. President,—The Council held its regular meetings as laid down in the Statutes. At the first meeting (the late Mr. Foster, then a member of Council, having been elected vice-president), the Council under the authority of the Statute appointed Mr. James Dickson on the Council for the remainder of Mr. Foster's term. During the last meeting of the Council Mr. George Ross was appointed to the position of vice-president for the remainder of this year, owing to the untimely death of Mr. Foster. The Council reports with sorrow his loss. His services on our Executive were of great assistance, and it was with pleasure that we were looking forward to his assuming the duties of president, which no doubt would have fallen to him at this meeting.

During the year the By-laws have been revised, and I now present a copy for official ratification by the Association. They number from 1 to 46. I also present a copy of the Rules of our Examinations to be ratified.

Referring to the recommendation published in the annual report with regard to the legislation which we settled upon at the last meeting in respect of amendments in the Registry Act, our deputation was referred by the Government to Mr. Guthrie, inspector of Registry Offices, who gave us a most attentive and courteous interview, which resulted in the amendments as passed last year. While in some details our proposals were not entirely carried out, all the important points were accepted almost in our own words.

I hoped, gentlemen, to have had the copies of the Manual here to present them, but we have just heard from the printers through some unfortunate delay in the binding they will not be here until to-morrow morning. The preparation of this Manual required considerable care not so much in respect to what should be put in it as to what should be left out, the first consideration being its portability, it being primarily intended for use in the field and for ready reference in the office. Perhaps some may say that some sections of certain Acts or a synopsis of them should have been inserted; for instance, those sections of the Municipal Act relating to roads and highways, their widths and the acceptance of them, etc. There are a great number of

sections and sub-sections in the Municipal Act which refer to this branch of the Municipal Act. We did not put them in the Manual because they do not directly concern the surveyor in the field. Reference is made to them, however, so that a surveyor can readily turn up what in the Municipal Act refers to roads. Certain sections in the Railway Act as to the duties of arbitrators were not put in for the same reason. The answer generally to an objection such as this is that we should have had to put all in; a synopsis alone would have done more harm than good. It is apt to lead astray, and it is better to let the surveyor read all the sections of every Act relating to roads.

Amongst the suggestions made by us as to part of the Registry Act, which were not adopted, was a proposed form of certificate for compiled plans. As you may remember, there is a difference of opinion as to what certificate should be used, some thinking that the proper certificate to be put on a compiled plan is the one which is already in the Act, Schedule O, Section 100. But if you will look at Section 100 of the Act you will see that the only plans upon which this certificate has to go is where any land is surveyed for the purpose of being resold, or conveyed in lots by reference to a plan which has not been already registered. That is the only kind of plan upon which the particular certificate in the Act is required. If you turn to the section which refers to the preparation of and compiling of plans you will notice that two certificates are required. The Act reads as follows: "Each map or plan shall have endorsed thereon the certificate of the clerk and the head of the municipality and the surveyor." Clearly the one—that is, the certificate signed by the clerk and the head of the municipality—is a certificate that the plan was prepared under the direction of the municipality; the surveyor signs a certificate that it was prepared in accordance with the provisions of Section 111 (or, as the case may be) of the Registry Act. Otherwise all the proposals that we suggested have been adopted, and the Act was passed last session. In the Manual that we have prepared we have revised Chapter 136 of the Revised Statutes in accordance with the provisions of that Act. The index has also been carefully compiled and considerable information in addition to the special Acts relating to surveys and other Acts that have reference to surveyors and their duties has also been added. It is, therefore, hoped that surveyors will not have much trouble in turning up and finding out what may be required of them under the whole limits of the Ontario Statutes.

The Council has also to report that after an interview with the Commissioner of Crown Lands he has given us the use of the rooms opposite the ones we now occupy; and as these are for ourselves only it would be proper for us to spend some money to equip them in a suitable manner in addition to what the Government may feel able to do for us.

Respectfully submitted,

VILLIERS SANKEY,

Chairman of Council.

DISCUSSION.

Mr. Sankey—I think with regard to the By-laws, gentlemen, that a special motion to adopt them as printed in this annual report is necessary, and we will have the official seal of the Association put upon them and filed away; in fact, I think the best thing to do is to bind them into a book. We have the By-laws here numbered from 1 to 46, and have them published in the annual report; also the rules of the Board of Examiners.

Mr. Dickson—I beg to move the adoption of these matters, and also the adoption of this report.

Mr. Watson—I second that motion.

Mr. Sankey—I beg to move that the report of the Council be adopted.

Mr. Niven—I second that motion.

Mr. Aylesworth—Is it in the conditions of the Registry Act that you are not to use pen and ink in copying books or plans in these offices?

Mr. Sankey—I am not aware of that in the Registry Act itself. I have seen in the Registry Office a notice in the book that no pen and ink is to be used on the books.

Mr. Aylesworth—And some Registrars say that we have no right now to take copies without charge.

Mr. Sankey—I will not say it is not in the Act.

Mr. Aylesworth—I think you will find it in the Registry Act. I do not think that restriction came from this board.

Mr. Sankey—It is new to me.

Mr. P. S. Gibson—Although that is found in the Registry Act there is no penalty.

Mr. Aylesworth—But you cannot do it if the Registry Act says it is not to be done.

Mr. Gibson—No.

The President—If that provision has been inserted in the Registry Act we certainly should take some means to have it remedied. My idea has always been that surveyors should be entitled to look at any plan in the Registry Office free of charge. Surveyors ought to have all the information they can get, and not be limited by having to pay for every little thing they want to look at, and perhaps not have to use it at all. Registrars in a great many counties get more in the way of fees than they ought to get in return for the work they do, and a provision of that kind would be a great benefit to the country at large. I do not think any surveyor would abuse the privilege of looking up plans; in fact, I think in some of the Registry Offices surveyors are allowed to look at any of the plans without charge. There is a striking contrast to the methods pursued in the United States. Last fall I was in the Registry Office in the City of Brooklyn (Queen's County Registry Office). There, there is no charge to the public for making any search ; all the plans received in the Registry Office are copied immediately in books, and the original plans are filed away, and the books, properly indexed, are free to the public, to surveyors and to others to come in and get all the information they can get to make a survey properly. And in the same way the deeds and mortgages are there for those who wish to search them to do so, and return the books with the copies to their proper place; and the system seemed to work perfectly. We are certainly very much behind the times here in this way of tying up information that ought to be free under proper restrictions.

Mr. Van Buskirk—I think the Registrars are very lax in carrying out the law in regard to having proper plans made; and it might be a good thing for all of us if we could bring some pressure to bear upon them to have their plans put in proper shape. Take, for instance, the plans of towns. A great many of the towns are not up to date by any means, and the unregistered plans of the towns are of no use on that account; and I understand it to be the duty of the Registrar to demand proper plans from the towns and municipalities.

Mr. Sankey—I think in answer to that remark that all we need to do is to write the inspector of Registry Offices, and he has power under the Act to order every plan over ten years old to be brought up to date. He has power to do what, in his opinion, is right, if the complaint is well founded.

The President—It seems to me that if something were done to adopt the system pursued in the United States—in some of the States at least—to file away the original plans, and keep them so that they will not become worn out, and make tracings, and have them properly mounted in books, that would really be a great saving to the country. Now, in these copies that are shown to the public they are all made on a uniform scale, no matter what the scale of the original plan is, and they date away back to 1800, and before that they have all been plotted on a uniform scale, that is, 100 feet to the inch; and all information is free to the public. Even if they are not made free, if the old fee system is continued, it should be adopted that the original plans are filed away, and not mauled around and destroyed the way they are now. You go into some of the Registry Offices, and they hand you out a roll. About half the package is damaged on top, and you have got to guess at the name. Now, if those original plans were filed away, probably they would not have to be looked at once a year, but the copies might be made on good, serviceable linen, and mounted in books.

Mr. P. S. Gibson—What size would these books be?

The President—Most of the books were in portfolios, about two feet by three. In other cases they had them rolled up; they had files, looking something like the end of a boiler, with a covering over each tube, and the plan was rolled up in that tube; and you look at your index, go to the number of the tube and get the plan.

REPORT OF THE BOARD OF EXAMINERS.

The following, gentlemen, is the report of the Board of Examiners:

The Board of Examiners met at the office of the Hon. the Commissioner of Crown Lands on Monday, February 12th, and following days as provided by statute. The following candidates passed the required examinations:

PRELIMINARY.

Clarke, Leonard, Oswald, London.

FINAL.

Stull, William Walter, B.A.Sc. (Toronto), Sudbury.
Fairchild, William Howard, Simcoe.
Shaw, John Henry, Grad. S.P.S., Pembroke.
Weekes, Melville Bell, B.A.Sc. (Toronto), Brantford.

The successful candidates for final examination were duly sworn and admitted to practice.

BONDS APPROVED AND FILED.

Reinhardt, Carl.
Carpenter, Henry Stanley.
MacKay, James John.

At the above examination the marks as revised were adopted, and were found to be satisfactory to the Board.

Articles have been filed by the following pupils with the following masters, etc.:

ARTICLES FILED (BETWEEN FEBRUARY 1899 AND FEBRUARY 1900.)

NAME OF PUPIL.	NAME OF SURVEYOR.	RESIDENCE.	DATE OF ARTICLES.	TERMS.
Beaton, Wm. A.....	Moore & Henry.....	London.....	Feb. 17, 1899	Three years
Stull, W. W., B.A.Sc (Toronto)	DeMorest & Silvester.	Sudbury.....	Feb. 13, 1899	One year
Fillmore, Stanley H.	James A. Bell.....	St. Thomas...	Feb 20, 1899	Three years
Robinson, A. H. A., Grad. S.P.S.	L. V. Rorke.....	Sudbury.....	June 1, 1899	One year
Paterson, Herbert...	C. F. Miles.....	Rat Portage...	Aug. 1, 1899	Three years
Benson, Robt. Lane..	V. M. Roberts.	St. Catharines	Jan. 2, 1900.	Three years

VILLIERS SANKEY,
Chairman of Board.

REPORT OF THE SECRETARY-TREASURER.

Mr. Chairman,—I beg leave to submit the following Report of the official business of the Association transacted in my department between 28th February, 1899, and 27th February, 1900:

The following circulars were issued:

No. 48	Ballot for 1899-00	225 Copies.
" 49	Explanation of ballot with names of candidates	225 "
" 50	*Re* Canadian Society of Civil Engineers' Ontario Bill	225 "
" 51	Announcement of annual meeting for 1900	275 "
" 52	Request for return of copies of Survey Act	225 "
" 53	Programme for annual meeting, 1900	400 "
" 54	*Re* Change of date for Annual Dinner	250 "

Letters, post-cards and accounts sent	960
Letters and post-cards received	510
Copies of Exchanges sent to members	800
Copies of Proceedings shipped to Exchanges	470
Copies of Proceedings sent to members	227

Copies of the 1899 issue of Reports from the Engineering Society of the School of Practical Science, Michigan Engineering Society, Illinois Society of Engineers and Surveyors, Indiana Engineering Society and Iowa Civil Engineers' and Surveyors' Society have been sent to all members not in arrears for the current Association year.

The Proceedings of Ohio Society of Engineers and Surveyors for 1898 and 1899, Wisconsin Engineering Society for 1898 and 1899, and the Purdue Society of Civil Engineers for 1899 have not yet been received, nor have our Reports for 1899 been forwarded to these societies.

During the past year six new members have been enrolled, of which number four were admitted by the Board of Examiners at its recent session, and one withdrawn member has re-registered. Six active members have withdrawn their names from the list of practitioners, and death has removed Messrs. Jos. Kirk, F. H. Lynch-Staunton, James Hales Reid and F. L. Foster. The register now stands as follows: Active members, 227; withdrawn members, 60; dead, 28, a total enrolment of 315 members since the incorporation of the Association in April, 1892.

The attention of the members is drawn to the work each year being done by the various standing and special committees. Each has important duties, the details of which amount to much more than can be seen by a perusal of the reports. The Land Surveying Committee serves as an advisory council to some of our members, who, owing to their remoteness from Toronto, are

unable to attend the meetings, and the interchange of ideas resulting from the knotty problems submitted form an important addition to the value of association. The papers secured by the Drainage and Engineering Committees are carefully read by members interested in these branches of practice.

The Committee on Topographical Survey has been working away with the object of arousing the powers that be to a recognition of the fact that our fair Dominion is away behind the age in that essential, and that Committee should have the credit due it when, in the future, a triangulation survey is inaugurated. We have, from time to time, had able reports from the Exploration Committee, whose advice in carrying out the new policy of the Government may be found valuable. Upon the Publication Committee falls much of the drudgery of the Association, but it has always been performed cheerfully and as promptly as the many exigencies permit. The labors of the Entertainment Committees speak for themselves in the constant improvement in the method of conducting our annual recreation.

Work in the Repository and Biography Committee has been delayed for the past few months pending the fitting out of our new quarters, when it is expected that it will be prosecuted with renewed vigor.

The appended financial statement shows that the Association is now on a substantial basis in that respect; and I am glad to be able to report that the number of members in arrears is growing smaller. In the majority of cases those in arrears have the best of excuses, which the increased demand for the services of our profession will doubtless soon remove.

Another point upon which the Association is to be congratulated is the spread of active interest evinced by its members. Our oldest professional representative, who has been a duly authorized land surveyor for more than sixty-one years, has this year prepared a paper for the meeting, and already more than a dozen members have signified their intention of contributing to the programme for 1901. A larger percentage than usual of the papers on the programme relate to land surveying proper.

We have to regret the loss sustained by the death of our Vice-President, whose obituary appears in the "Proceedings" for 1899, and of Messrs. Kirk and Lynch-Staunton, to whose efforts our Biographical Section in past years is indebted for much information, which they alone could give.

The thanks of the Association are due to the Carnegie Steel

and Iron Co. for a copy of "Carnegie's Pocket Book"; the A. & P. Roberts Co., for a copy of "Steel in Construction"; the editor of "The Surveyor," London, England, for continued donation of that valuable publication; to Mr. A. Kirkwood, for a sufficient number of copies of his translation of a pamphlet on "The Art of Observing" to supply all our members, and to numerous other donors. The Annual Reports of the United States Coast and Geodetic Survey, the Geological Survey of Canada, the Dominion Archives and the Ontario Reports of the Bureau of Mines, and Bureau of Industry and Forestry have been received regularly through the kindness of the officers in charge.

In concluding my tenth Annual Report permit me to thank the members for the uniform courtesy accorded their Secretary, and for the loyalty with which they have supported the Association.

Respectfully submitted,
A. J. VAN NOSTRAND,
Secretary-Treasurer.

STATEMENT OF BALANCES, RECEIPTS AND EXPENDITURES BETWEEN 28TH FEBRUARY, 1899, AND 27TH FEBRUARY, 1900.

DR.

To balance on hand, 28 February, 1899								$1,664 45
" Amount collected for advertisements in 1898 Report							$ 38 00	
" " " " " 1899 "							82 00	
" " " for Proceedings sold							50	
" " " for Certificate							50	
								121 00
" " Registration Fees	6	at	$1.00	each			6 00	
" Annual Dues for 1893-4,	2	"	4.00	"			8 00	
" " " " 1894-5,	1¼	"	4.00	"			5 00	
" " " " 1895-6,	1	"	4.00	"			4 00	
" " " " 1896-7,	1	"	4.00	"			4 00	
" " " " 1897-8,	6¼	"	4.00	"			25 00	
" " " " 1898-9,	19	"	4.00	"			76 00	
" " " " 1899-0,	160	"	4.00	"			640 00	
" " " " 1900-1,	9	"	4.00	"			36 00	
" Commuted Arrears	1	"	5.00	"			5 00	
" Associate Fees	3	"	2.00	"			6 00	
								815 00
" Accrued interest on Savings Deposit								41 11
" Receipts in Board of Examiners' account (including Government grant of $200.)								432 00
								$3,073 56

CR.

By amount for Publishing Proceedings of 1899 meeting			$374 30		
" " granted to Secretary-Treasurer for 1898-9			200 00		
" " Paid for postage			58 20		
" " " " Printing and Stationery			52 10		
" " " " Extra Copies 1899, Exchange Reports			39 00		
" " " " Stenographers' Fees reporting Annual Meeting, 1899			35 00		
" " " " Expenses of Members of Council			20 10		
" " " " Binding and mounting			11 85		
" " Granted to Auditors			10 00		
" " Paid for Freight, Express, and Shipping Charges			7 81		
" " " " Furniture for Repository			3 00		
" " " " Customs Brokerage			2 00		
" " " " Cartage			1 60		
" " " " Bank Commissions			1 35		
" " " " Telegrams			50		
" " " " Office Sundries			25		
					$ 817 06
" " " " Disbursements in Board of Examiner's Account					217 35
" Balance on hand in Savings Bank		$1,403 05			
" " " " in Current Account		636 10			
					2,039 15
					$3,073 56

A. J. VAN NOSTRAND, Secretary-Treasurer.

I have also, gentlemen, to hand you the certificate of the auditors, which reads as follows:

Toronto, Feb. 28, 1900.

We hereby certify that we have examined the accounts of the Secretary-Treasurer, and vouchers therefor, also Financial Statement, and have found them correct.

Respectfully submitted,

A. W. CAMPBELL,
H. L. ESTEN,
Auditors.

REPORT OF COMMITTEE ON REPOSITORY AND BIOGRAPHY.

Mr. President,—Your Committee on Repository and Biography beg leave to report as follows:

The usual reports and exchanges have been received throughout the year, and the collection of technical works in the library is steadily increasing in proportions and value. Owing to the fact that the rooms in the Parliament Buildings at present occupied by the Association are required to meet the demands for space for the Surveys Branch of the Crown Lands Department, it has been found necessary to seek other quarters. We have been fortunate enough to secure the consent of the Honorable the Commissioner of Crown Lands to our transfer to a suite of three rooms on the opposite side of the corridor from those now occupied by the Association.

The Government also, in consideration of the connection of our profession with the Crown Lands Department, have further arranged for fittings for the new rooms to meet the main requirements of the Board of Examiners, but in order to have these rooms made suitable it may be necessary to draw upon the exchequer of the Association for a moderate amount. When all is completed it is confidently expected that a great improvement in every way will result from the change, and that the next annual meeting will find us in quarters much more suitable than heretofore. Your Committee would ask the co-operation of all Ontario land surveyors in the collection of data relating to early surveys and surveyors. Slight reflection is necessary to convince us that the passing of each year seals forever one or more sources of information, and valuable history is thus irretrievably lost to the country. "Let us, then, be up and doing."

Respectfully submitted.

(Signed), WILLIS CHIPMAN,
Chairman.

REPORT OF COMMITTEE ON ENGINEERING.

[Owing to the numerous engagements of the chairman, no meetings of the committee were held, and consequently no report is forthcoming.—Ed.]

REPORT OF COMMITTEE ON TOPOGRAPHICAL SURVEY.

Mr. President.—Your Committee on Topographical Survey beg to report as follows:

That the earnest endeavors made for these many years for the inception of a trigonometric or geodetic survey of Canada are at last giving hopeful signs for an inauguration thereof.

A question of such intrinsic merit in the development of our country and of our national life can only be benefitted by the fullest public discussion. With that end in view, many separate copies of the Committee's Report of last year were struck off for circulation among our legislators.

Your Committee regret that Canada was not represented at the Seventh International Geographic Congress, held at Berlin last September, as it meets only every five years. At this Congress a map was exhibited, which deserves especial reference. As you are aware, a chain of triangles has been expanded throughout the whole length of Finland; and now the Finnish Geographical Society has completed a remarkable atlas, shown at Berlin, "in which all the conditions of the land, natural and economic, are mapped with a completeness that has never been attempted for any other country. It even includes a map showing in horse-power the available energy of the rivers." In this, well may we emulate the Grand Duchy of Russia.

Since the last report of your Committee the Report of the Trigonometrical Survey of New South Wales has been received, and is replete with matters of interest. Queensland, too, has its trigonometrical Survey, so has Victoria, South Australia, Western Australia, and even Tasmania inaugurated one fifty years ago. To the splendid geodetic work done in South Africa by Dr. Gill references have been made on former occasions. The premier

colony of all, however—an appellation with which we are wont to clothe ourselves—Canada, has no trigonometric or geodetic survey. Until we have such no thorough topographical survey can be instituted nor reliable maps had.

However, there seems reason to believe that there is beginning to be a public awakening to the necessity of initiating this great work, not from scientific reasons, but purely from material reasons, as an essential link in our national progress and the development of our unrivalled resources now lying dormant.

All of which is respectfully submitted.

February 26, 1900.

Otto J. Klotz,
Chairman.

REPORT OF ENTERTAINMENT COMMITTEE, 1900.

Mr. President,—Your Committee on Entertainment for 1899-1900 beg to report as follows:

The question as to whether the Annual Meeting of the Association should be held in the Parliament Buildings or in some hall in the central part of the city was discussed by members of the Association and decided in favor of the former. The thanks of the Committee and the Association are due to the Honorable the Commissioner of Crown Lands for his kindness in securing for us the use of the Railway Committee-room for the more largely attended sessions.

Owing to the second day of the meeting this year falling on Ash Wednesday a change in the date of the annual dinner was deemed advisable, and it accordingly took place on the evening of Tuesday, 27th February, at McConkey's parlors. This date also was rather unfortunate, as several invited guests had already made engagements.

Amongst these were the President of the Canadian Society of Civil Engineers, the President of the Canadian Institute, the Honorable the Commissioner of Crown Lands, the Honorable the Provincial Secretary and Lieut.-Col. Geo. T. Denison.

In addition to the members present were Mr. Aubrey White, Assistant Commissioner of Crown Lands; Mr. Kivas Tully, Consulting Architect for the Department of Public Works; Major Mutton, R. F. Stupart, Meteorological Office; Mr. F. C. Jarvis, Barrister; Messrs. W. S. Skeats, C. M. Canniff, C.E., R. E. Speakman, C.E., and C. Dod.

The chair was taken by yourself, and the vice-chair by the vice-president, Mr. Geo. Ross. Justice having been done to the menu, the toast, "Our Queen," was loyally proposed from the chair, and as loyally received. "Our Empire," proposed by the chairman, was responded to by Major Mutton, and followed by "Soldiers of the Queen," sung by Mr. Canniff. "Our Dominion," proposed by the chairman, was responded to by one of our active members, who has recently been elevated to the Senate. Senator Casgrain, in speaking to this toast, quoted freely from the standard history of Canada in proof of the loyalty of our compatriots in Quebec.

From the vice-chair the toast, "Our Province," was proposed, and it was ably responded to by Mr. Aubrey White. "Our Guests," proposed by the vice-chairman, was responded to by Messrs. Tully, Stupart, Speakman and Jarvis. As volunteer toasts Mr. White proposed the health of Messrs. Kirkpatrick and E. Stewart, and Mr. Niven proposed the health of Mr. W. R. Aylesworth. The toast, "Our Ladies," was responded to by Messrs. Esten, Speight and Skeats. The toast list was further enlivened by the following songs: "The Absent-minded Beggar," by Mr. Canniff; "The Boys of the Old Brigade," by Major Mutton; "Bacon and Greens," by Mr. Niven; "The Extension of the Railway," by Mr. Sewell; "Teddy, the Tyler," by Mr. W. A. Browne, and "Bonnie Dundee," by Mr. Niven. "Auld Lang Syne" and "God Save the Queen" concluded a very pleasant evening's relaxation.

A detailed report of financial transactions is filed with the Secretary-Treasurer.

All of which is respectfully submitted.

A. J. VAN NOSTRAND,
Acting Chairman.

REPORT OF PUBLICATION COMMITTEE.

Mr. President.—The Committee regret the delay that occurred in publishing the Report. We hope that, notwithstanding a few omissions by the printers, the result of our pleasing labors may not be deemed altogether unsatisfactory. The diagrams accompanying papers are rarely suitable for publication, and a good deal of labor is expended in reproducing them.

The thanks of the Association are due to Mrs. Amy Moss and Mr. Justice Moss for their kindness in giving information

regarding the life of Surveyor-General Sullivan for our biographical sketch.

Thirteen hundred and fifty copies of our Report were printed by Messrs. Henderson & Co. at a cost of $374.30.

The members of the Association should not be forgetful of the interests of our advertisers.

We have exchanged Reports with the following societies:

School of Practical Science Engineering Society	200
Michigan Engineering Society	130
Ohio Society of Surveyors and Civil Engineers	100
Illinois Society of Engineers and Surveyors	130
Indiana Engineering Society	75
Iowa Civil Engineers' and Surveyors' Society	70
Wisconsin Engineering Society	20
Purdue Society of Civil Engineers	90
	815

Respectfully submitted.

KILLALY GAMBLE,
Chairman.

REPORT OF EXPLORATION COMMITTEE, 1900.

Mr. President.—In former Reports of your Committee repeated statements have been made as to the desirability of a thorough system for the exploration of our unoccupied territory being adopted. For this purpose as yet no systematic effort has been made. An immense area of our Dominion still remains not only unoccupied, but as to its resources and capabilities of production almost unknown. This almost unlimited field still remains, awaiting the explorer, geologist and surveyor.

It is not many years past when large portions of our territory were spoken of as seas of mountains and wildernesses of rocks, lakes and swamps. What do we now see? These, then, despised, because unexplored districts, the most valuable feeders for our most extensive railway system. All praise to the excellent work done by the staff of the Geological Survey, who, in years past, were our only true explorers! We have the money, and we have the men. Why not devise some systematic method, and press

on the work until every square mile of our great inheritance has been reported on and correctly mapped?

There can be no doubt in the minds of the members of the Ontario Land Surveyors' Association as to who the proper men are to undertake this great work. Every year our colleges and O. L. S. Board of Examiners are improving the preparation of our members for just such an undertaking. The lines termed "base lines" and the boundary lines, as lately run, have, we submit, hitherto too closely adhered to the mathematical definition, "length without breadth," to be correctly termed exploration lines. Your Committee would earnestly press upon the Association the necessity of, without any delay, discussing, arranging and submitting to the Government a proposed system of exploration. As to the method to be adopted, many suggestions have been made. That the line of exploration, while being so run as to supply information for a correct plan, should not be confined to a specific direction, but varied in its course at the discretion of the explorer. That at certain intervals of distance lateral explorations shall be made, on both sides of such main line, to the distance of three to ten miles: that where the course of a river can be utilized, its course be sufficiently accurately ascertained, and lateral explorations made in a similar manner as in former case. In case of an extensive survey, supply depots could be established at defined points for convenience of assistant explorers. In all cases we would submit that the modern system of warfare be adopted. Put a qualified and reliable man in charge: do not encircle him with a quantity of "red tape," and give him, as far as reasonable in the case, a free hand.

We leave it in the hands of our comrades of the Topographical Surveying Committee to follow in pressing on that most important, and what is more illustrated every day, absolutely necessary work for every civilized community, the filling in of the details after the reports of the explorers have been recorded.

February 26, 1900.

M. GAVILLER,
Chairman.

REPORT OF COMMITTEE ON LAND SURVEYING.

Mr. President,—Your Committee begs to report that during the past year land surveying business has still continued to increase throughout the Province of Ontario, which is without doubt due to the general growth of prosperity our whole Dominion is now enjoying, and the actions our government are taking in providing for the development of our vast agricultural and mining resources, which were never more prominently set before the eyes of the whole world than they are to-day.

We are also pleased to learn of the united action by all interested, in larger proposals now being brought into consideration by our Government, viz., explorations in the northern parts of our Province for the still further developing of nature's wealth.

Your Committee would urge upon the members of the Association the importance of sending into this Committee, in the form of questions any peculiar cases they may meet with in their practice during the year. The practical information given by the members arising from discussion upon the questions is much appreciated by all, and greatly adds to the value of our Proceedings when printed and sent abroad.

A variety of questions in all branches of our profession would be still more interesting.

Questions in surveying have been sent in to your Committee which with replies have been appended hereto.

All of which is respectfully submitted.

HAROLD H. GIBSON,
Chairman.

February 27, 1900.

QUESTIONS.

A road allowance is shown along the Muskoka River on original plan and field notes, and although never used for public travel it has not been closed or dealt with by council.

A plan of subdivision is filed in 1872, showing lots running to water's edge with no road allowance and lots are conveyed according to this plan, also a subsequent corporation plan duly signed by the officers shows no road allowance.

The property is enclosed by a fence excepting along river.

The present council claim this road allowance and instruct their engineer to lay water pipes along it.

Question 1.—Can the engineer and workmen be prosecuted for trespass for entering upon this land. Ans.—No; providing council have passed the necessary by-law for opening the road when it is in the possession of a private party.

Question 2.—In making a new corporation plan should this be shown as a road allowance. Ans.—Yes.

The accompanying plan shows part of the Great Northern Road survey through the Township of McKellar. The lots were laid out in the original survey in two concessions, A and B, on either side of the road, being posted along said road on which they front. The posts along the road are all gone from side-road 18 and 19 to side-road 23 and 24. The road is opened and traveled, and runs through a clearing, so that no blazed line can be found, and the points where the various angles were made in the road are not marked on the ground. There are no posts planted on rear line of these road lots (except at the side-roads) as shown by the field notes.

Q.—How would you make sub-division to get point from which to run line between lots 21 and 22, Concession B?

A.—Locate the angles in the road nearest to line between lots 21 and 22 by resurveying the road from nearest known points on each side of same. Between these angles give each frontage its proportional width to that intended in the original survey.

1. What is to be understood by the words, "alternate concession in Sub-section 2 or Section 37? A.—The word "alternate," we believe, was intended for "sectional."

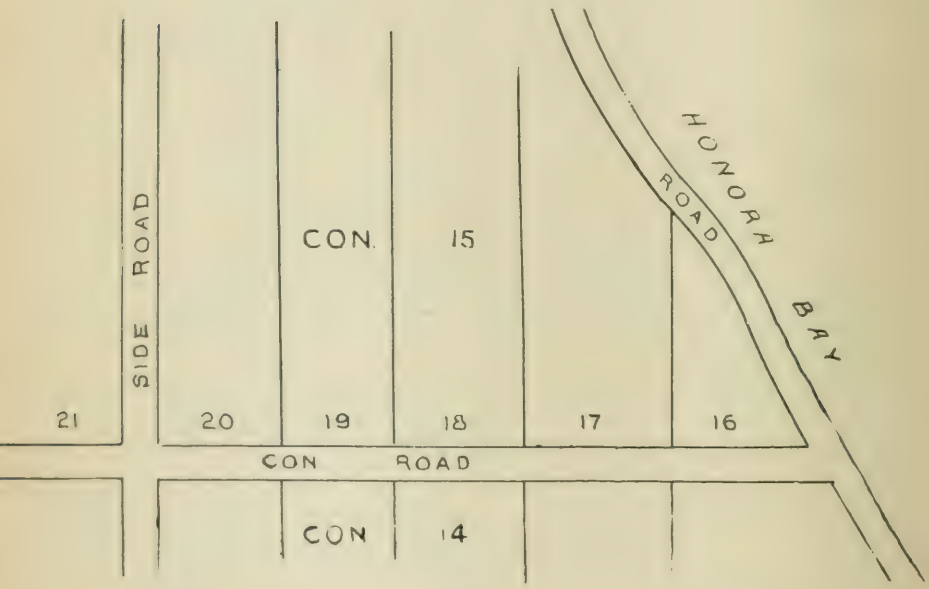
2. Can a municipal survey be made under instructions from the C. L. D. where a concession line is in dispute as to different stakes? A.—No.

3. Where, in an original township survey part of the township was only run out, but many of the lots throughout the whole township were sold, can the Government order the completion of the township survey without a petition from the municipality? A.—No.

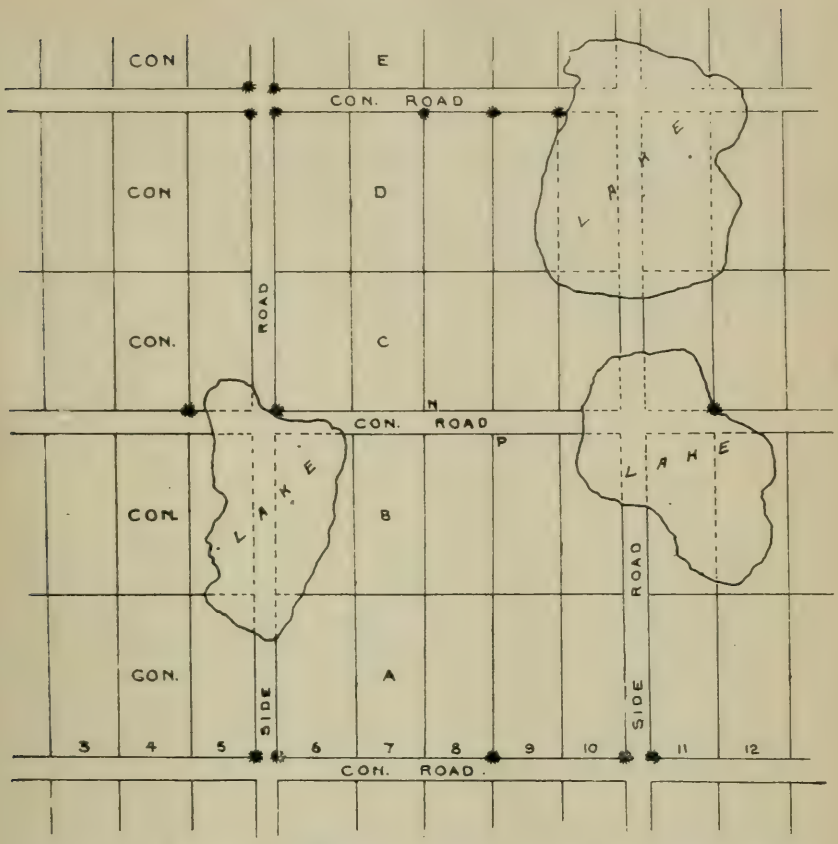
If made by the surveyor as a municipal survey under the Act, which Act he does not follow, is his survey legal? Say he made the survey in the year 1854? A.—No.

The next diagram shows a portion of a township laid out

in accordance with the order-in-council as mentioned in Section 28, Survey Act, R.S.O., 1897, i.e., in sections or blocks. The governing boundary of the block or section in Con. 15 is broken by Honora Bay. Should the lines from 16 to 20 be run according to the astronomical course as shown in the original



notes, or should they be run parallel to line between 20 and 21, which line between 20 and 21 is supposed to have been run in original survey? The township does not come under Subsection 2 of Section 28. A.—Run side lines on same course as line between lots 20 and 21.



Note.—Asterisk (*) denotes where stakes are now standing.

In the above sketch are shown sectional surveys run out after passing of order-in-council of March 27, 1829. See Sub-section 1 of Section 28 of Survey Act. The sections are not in townships mentioned in Sub-section 2 or Section 29.

1. Q.—How should line between Lots 8 and 9 in Con. A be run? A.—On same course as sideroad between Lots 5 and 6 as determined by posts at corners of lots 5 and 6, Con. A, and of Lot 6 in Con. C.

2. Q.—How should line between Lots 8 and 9 in Con. B be run? A.—On same course as side-road between Lots 5 and 6 as above stated.

3. Q.—How should line between Lots 8 and 9 in Con. C be run? A.—On same course as side-road between Lots 5 and 6 as determined by post at corner Lot 6, Con. C, and Lots 5 and 6, Con. D.

4. Q.—Should lot lines be shown as on sketch within lake limits. A.—It is not the practice of the Government, but under many circumstances they should be.

5. Q.—How should you find corners N and P? A.—Intersect concession line B and C with side-road 10 and 11, and subdivide from point so found to post at corner, Lot 6, Con. C.

DRAINAGE COMMITTEE.

To the Association of Ontario Land Surveyors:

Gentlemen.—I find it impossible to thoroughly review the drainage work of the Province during the last year, since the labor and expense of collecting statistics in detail is far greater than can be undertaken by members of this Association.

It occurs to me, however, that such statistics might be collected and published without great expense by the Department of Agriculture; and I am satisfied that, in view of the interests involved, the information would be of much value, not only to members of this Association, but to the Province generally.

In so far as I have been able to ascertain, work under both the Drainage Act and the Ditches and Watercourses Act is not falling off, although the sanguine expectations of the public that litigation would be decreased under the revised Acts have not been realized.

There appears to be much dissatisfaction and difficulty in working under some of the recent amendments to the Acts, and it would seem advisable to have some of these matters brought to the attention of the Legislature. I cannot, however, recommend that action be taken by the Association, as I am strongly of opinion that we should interfere as little as possible in matters of this character. It is our business to work under the Acts as they are, and according to the construction put upon them by the courts; and should any member of the Association feel disposed to question the ruling of the county judge or of any other

court, it might be well for him, both in his own and his clients' interest, to remember the advice given by "Punch" to those about to be married, "Don't."

The working out of any drainage scheme, and its attendant assessment, is an extremely difficult operation, and requires not only a thorough knowledge of the Acts on drainage, but also a knowledge of the decisions of the various courts. Again, to thoroughly understand and properly apply the dictum of the court, it is necessary to have a knowledge of the particular drain and watershed reported upon before comparison can be made with the case in hand.

There are, however, a few general principles of "judge-made law" which apply to all cases; therefore a study of reported cases will greatly assist an engineer in working out any drainage scheme.

The apportionment of assessment between "benefit," "outlet liability" and "injuring liability" is doubtless the most frequent cause of difficulty. "Benefit" is generally dealt with by the Court of Revision and the county judge; consequently we have few reported cases bearing on this point, and the Association can do good work in collecting such decisions. I have attached to this report the decision on a somewhat peculiar case, which, I trust, may be of interest.

The "outlet" and "injuring" liability question is one upon which many court decisions have been given, but as few important rulings have been made since the reconstruction of the Drainage Act in 1894, we cannot tell whether the courts will or will not hold that the Legislature intended to override the common law rights of landholders.

Mr. Gardiner has contributed an interesting discussion upon the above question, which is submitted herewith. I recommend that the cases of "Metcalf vs. Ekfrid" and "Broughton vs. Grey" be studied in connection with it. In conclusion, I may state that I am of opinion that a study of the common law, in so far as it relates to water and watercourses and the rights of riparian and other landowners, will be of great service in the practice of the drainage engineer.

W. F. Van Buskirk, O.L.S.,
(M. Can. Soc. C.E.)
Chairman Com. on Drainage.

IS A NATURAL WATERCOURSE A "SUFFICIENT OUTLET" UNDER THE DRAINAGE ACT OF 1894?

Interpretation clause No. 11 of the Municipal Drainage Act explains that "sufficient outlet" shall mean the safe discharge of water at a point where it will do no injury to land and roads," meaning, it is assumed, in the case of artificial channels, a sufficient grade and cross-section to properly carry the water.

The Chief Justice of Ontario, in Stephen vs. McGillivray, 18 A.R., page 54, says that:

"The mere ordinary clearing up of the country whereby the water ran off through the natural streams cannot, I think, be a reason for charging that water is caused to flow upon and injure lands lower down, within the apparent intention of the statute."

In Orford vs. Howard, 18 A.R., page 505, Maclennan, J. A., says:

"But when they get to McGregor's Creek they get an outlet, which they have a right to use, and they have no further concern with the water when it has reached that point. I think by the common law it is the right of every landowner to drain his land into any natural watercourse accessible to him."

This would seem to indicate that a natural watercourse was esteemed a sufficient outlet under the law of 1887.

Court of Appeal, Harwich vs. Raleigh. Mr. Justice Maclennan says.

"At the outset it is a somewhat startling proposition to say that the Legislature has enacted that landowners shall be chargeable with large sums, for which there can be no pretence that they have or can receive any benefit. Such legislation could hardly be called by any other name than confiscation, and before we can uphold the judgment of the learned referee we must be very clear that such is the meaning and intention of the language used by the Legislature."

The same authority asserts that the right to use a natural watercourse has been recognized ever since the year 1834.

In Broughton vs. Grey and Elma, the unanimous decision of the Supreme Court was that:

"The Act of 1892, equally as that section in the Act of 1887, applies upon the question of outlet, only to drains properly so called, and does not extend to nor include original watercourses

which have been deepened or enlarged. Indeed, the contrary opinion appears to me to be wholly inconsistent with the principle upon which the whole of the legislation upon the subject is founded."

It appears that up to the enactment of 1894 a natural watercourse was regarded as a "sufficient outlet."

The above, it may be said, is "ancient history," but does it not concern us when considering the amendment of 1894. The learned referee, in his judgment, Harwich vs. Raleigh, remarks that:

"If in subsequent laws other powers are given, and other modes of proceeding provided, the natural inference is that such new laws are auxiliary to the old."

Therefore, in an endeavor to determine our duty under the law of 1894, are we not justified in regarding the amendments therein as auxiliary to the old law, and are we not more than justified in having due regard to the expressed opinions of the learned judges in their interpretation of previous legislation as it comes to us in the reported cases?

From this source we find on the authority of Chief Justice Hagarty, Stephen vs. McGillivray, that

"The mere ordinary clearing up of the country whereby the water ran off through the natural streams cannot be a reason for charging that water is caused to flow upon and injure lands lower down."

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Mr. Justice Osler, in his remarks, Harwich vs. Raleigh, expresses the opinion:

"That if the Legislature meant to place such an extraordinary burden upon an upper township as is here sought to be placed by Raleigh upon Harwich, which neither needs, nor is benefited by the proposed works, they would have said so in clear and unmistakeable language."

Does the amendment of 1894 express in clear and unmistakeable language that such was the intention of the Legislature?

Mr. Justice Burton, the dissenting judge in appeal, Orford vs. Howard:

"Did not for a moment assume that parties could be assessed in respect of an outlet for water which naturally flowed into the drain from the upper part of the same watercourse," but he asserts:

"It is a very different matter when water is brought from another part of the upper township, which would never have found its way naturally into the stream."

In Harwich vs. Raleigh the same learned judge remarks that:

"The amendment to Section 590 was made no doubt, in consequence of the division of opinion in this court in the case of Orford vs. Howard."

The conditions under which the division of opinion originated, it is seen, was the bringing of water "from another part of the upper township, which would never have found its way naturally into the stream." The principle laid down by the Chief Justice regarding the ordinary agricultural improvement of the land is unchallenged, and no attempt is made to define or restrict those rights, but authority is sought to enable assessment to be made on lands, the water from which would never have found its way naturally into the stream, nothing that can be construed as confiscation or interference with existing rights, simply an amendment to authorize an assessment in exceptional cases where injustice might be done to the lower lands.

From the similarity of the language used by the learned referee in his comments in the case of Harwich vs. Raleigh to that used in Sub-section 5 of Section 3 of the Act of 1894 there is little room for doubt that this amendment owes its origin to that case; the difficulty he experienced in reaching a conclusion,

owing to the exceptional conditions found in the drainage area is thus referred to by the official referee:

"None of the 'creeks' in the present case can be compared with McGregor's Creek in Orford vs. Howard. The water between ridges or banks is called a 'creek'; it then spreads out over low, plain land, and is again collected into a drain.

"They caused more water to flow upon Raleigh than would naturally have flowed there, and they brought water more rapidly upon Raleigh than would naturally have come. The water now complained of has been increased in quantity, and the velocity with which it has come into Raleigh has been increased."

It is also remarked that:

"No doubt there is difficulty in construing Section 590, and it may be that it was not intended to apply to such cases as this."

But the learned referee considered it his duty to sustain the assessment against the higher lands, and the Court of Appeal, on an equal division, sustained the judgment, but this decision is overruled by the Supreme Court, showing that in the opinion of that Court the rights of the individual in a natural watercourse, even when of an exceptional character, had not been changed by the legislation of 1892. It was the exceptional character of the drainage area that occasioned the difficulty found by the official referee in reaching a conclusion. Is it not reasonable, therefore, to assume that the amendment of 1894 was intended to provide for such exceptional conditions; but when, considering the value of the amendment, it appears essential to have regard to the action of the Supreme Court, and also to determine if the language used is so "clear and unmistakeable" as to warrant the conclusion that a radical change in the law was intended. No attempt is made to define the term, "causing water to flow upon and injure," nor to define the lands to be assessed. Directions are given to have regard to the volume of water, and to the speed with which it is caused to flow into the drains. The particular lands liable are still to be determined according to the judgment of the engineer or surveyor, Court of Revision, County Judge or referee; but considering the decision of the Supreme Court, can this amendment be regarded as applying to original watercourses, whereby "the principle upon which the whole of the legislation upon the subject" will be set at naught, and the principle of confiscation introduced.

Re Appeal Canada Co. from Assessment under By-law No. 388, Township of Ellice. W. F. Van Buskirk, Engineer.

Judgment.

In the Matter of the Appeal of the Canada Company, the owners of Lots numbers 12 in the 11th, 12th and 13th Concessions of the Township of Ellice against the decision of the Court of Revision on the appeal thereto of the said Company from the assessment of the Engineer under By-law No. 388, provisionally passed by the said Township on the 29th March, 1899.

The hearing of the said appeal began before me on the 30th day of May last, when at the request of the Canada Company it was adjourned to take further evidence. Whereupon on Monday, the 19th day of June last, I proceeded to take further evidence, and, having heard all parties, I have come to the conclusion that I ought not to disturb the said assessment. It may be that it is not strictly exact to the extent fixed by the said engineer, but I cannot find any evidence upon which to fix with any satisfaction any other assessment lower than that of the engineer. I certainly think that, from a purely agricultural standpoint, the lands may not be benefitted at all by the supposed drain; but as peat lands the lots are valuable, realizing, in fact, more than lands reasonably fit for agriculture in the neighborhood. Then the question comes, Having a value, are these lands benefited by the proposed drainage? Mr. Dickson, witness for the Company, states that it is necessary to have the peat dry, but that if a dredge be used to scoop up the peat, then drainage by drains is undesirable; but if no dredge is used, without drainage (if very wet) the peat cannot well be secured by manual digging. The latter fact is almost self-evident. I have no evidence that it is the purpose of the vendees of the land to get a dredge; and I do not think the Company would set up that contingency to escape an assessment for a drainage, which is certainly necessary to make accessible their peat lands, except only in the event of one of Mr. Dickson's dredges being used.

Without such artificial means these peat bogs can only be worked by being drained. I don't think I should assume the substitution of artificial means for drainage, more particularly when I have no evidence that such are to be employed.

As to the course of the drain, its direction, and as to all other points raised in opposition to the proposed drain, counsel for the Company practically made an abandonment. I, therefore, dismiss the appeal with costs.

JOHN A. BARRON (J.).

4th July, 1899.

PAPERS.

[*This Association is not responsible as a body for the opinions expressed in its Papers by Authors.*]

SAMPLES OF A COUNTRY SURVEYOR'S LIFE.

By HAROLD H. GIBSON.

Surveyors may be divided into three classes: (1) City surveyors, (2) Country surveyors, and (3) those performing Government work. Among the latter class might also be placed all those surveyors who do not permanently reside in some particular locality, but rather follow up their work in various parts of the country, as in the case of surveyors who make a specialty of laying out railroads.

As to the personal advantages of any one of the three over the others there would certainly be decided differences of opinion if a decision were called for. For some of us appear to enjoy sampling the life of each during the year, and, like as in everything else, it is certainly well that all do not attempt to cling to any one class.

The writer in penning this article only hopes to point out some features that appear prominent in the country surveyor's life, although sometimes the same might also be noted in either or both of the other classes as more or less prominent.

In the first place it appears to him that the country surveyor's life is the happy medium. For one reason he has not got too much to do, and for another he escapes the hardships, and at times the privations, respectively, of the members of the other classes, which are both very serious considerations, and should be well weighed before being entered upon.

Now, what is a country surveyor? He is one who lives away from the cities, and may reside in some small town, village, hamlet, or even on a farm in some rural district. And in such a location, if he does not know everybody, everybody knows him, and knows him as the surveyor. Being an educated and professional man, he takes the highest stand in society, and should be

known for his probity, sobriety and uprightness in the discharge of his duties.

He possesses horses and carriages as well as a roomy office, well lighted, and fully equipped with all necessary furniture, and surveying and draughting instruments suitable for his particular line of local work.

In very many cases he is looked up to as an adviser or counsellor among the inhabitants of his district, which may encircle many miles of territory. For example, if any important business transaction or commercial enterprise is to be undertaken, often the matter is laid before him for his scientific opinion, upon which great reliance is placed. Reliance, however, depends to a great extent upon the length of time he has resided and carried on his business in that locality and his success therein. As time goes on a surveyor grows mighty in the good habit which the law requires of him, to deal justly in the discharge of his duties. Therefore, the longer he lives the more respected he becomes.

The country surveyor, when he first sets up business, may have very extended ideas as to what his future will be, but as time goes on he will often, if not in all cases, find (that is, if he is depending upon his profession as a livelihood) that he must also engage himself in one or more other lines of business. A prominent late surveyor used to say that "if any surveyor started out with the intention of making a living out of running side lines all his life he had better stop at once and go to farming." This is doubtless a fact with many of our country surveyors, and, perhaps, all would find it to be the case, even in the most favored locality. The demand for country surveying is so small that one can only live contented with the fact that his expenses are also quite low. So, when the young surveyor finds that he must also enter into some other business, he begins to see in real earnest (if it has not come to him before) the great advantages he derives from having in his young student days made a careful study of the Quadrivium sciences, or, better still, to have laid special stress on some particular branch or branches thereof, such as engineering, which additional occupation is so often chosen by our members, and appears to be the natural addendum of our profession.

It might be well to note here that for the above and many other reasons would it not be well for our profession, in order to procure a greater uniformity of knowledge among surveyors, that

the elementary subjects upon which engineering is based be introduced in the examinations. At the present time, many who present themselves as candidates have already taken a course at some engineering school, which is decidedly to their advantage, for there is no better foundation upon which an engineer can build than through having the practical knowledge which only a surveyor can acquire.

Not all country surveyors engaged in other lines of business besides their own do so for a livelihood, for some may choose to do so through their love of research in some more extensive field than that of our profession, which is very limited when compared with engineering and many other professions and occupations, which are endless in their possibilities for new ideas.

A country surveyor may be said to derive the advantages of not always being placed in a locality where entertainments of a social character are daily going on, excepting, the writer must admit, at least once a year, when he finds it necessary to visit the Queen City for a few days, and enjoy with his brothers in the profession one very sociable evening. He, therefore, has great opportunities of spending his evenings in his library, storing the limitless reservoirs of his brain with such practical information as he now knows from experience is most profitable for him in his business. In his office library will be found many commercial and scientific papers as well as the best dailies, and by a careful study of them, aside from his regular course of reading of heavier works, he keeps up with the times.

Law being the more important part of a surveyor's reading course, he naturally looks for the best and quickest method of acquiring the true meaning thereof, and he finds that by closely following the discussions in Parliament when the laws are being passed and the various interesting court cases, with the judges' opinions thereon, particularly of those reaching the Court of Appeal, that he can acquire abundance of facts to guide him in the discharge of his duties and place him in honorable positions before men.

Let us now observe some of the features of his surveying work which appear to strike us as most prominent.

ORDERS BY MAIL FOR WORK.

How very indefinite they are sometimes! Let us take a very good example. Here is the copy of a letter asking for surveying to be done at Smith's Corners, thirty miles from his office:

Smith's Corners, Feb. 3, 1899.

Dear Sir,—Could you pleas come and do sum survaying for me. Mr. Brown and his men are cuting trees in my bush and wont stop they ten me I must get a survayor to run the rite line, so pleas come at once.

Yours truly, JOHN SMITH.

Of course, Mr. Smith does not understand the great disadvantage to the surveyor in neglecting to state in his letter between which lots the survey is to be made; also the name of the township and number of concession, more particularly in this case as Smith's Corners adjoins three townships; and he requires the work to be done at once, so no time can be taken to write for particulars; therefore all that can be done is for the surveyor to collect together all the old field notes, plans and astronomic information relating to several of the lots, concessions and base lines in each of the three townships. It is also necessary for him to take along, besides his transit, a large compass to facilitate matters on the ground, if it is found possible to do the work with the compass and chain only; also various other articles and books, such as calculating tables, testament, small tools for repairs and instruments for draughting; also a Canadian Almanac, which is always improving for the use of surveyors in their astronomic work.

After having driven to Smith's Corners, or in the vicinity of his destination, it sometimes happens that the surveyor may be misdirected, and he will drive up a long lane, perhaps filled deep with snow, owned by one of Mr. Smith's cousins, two miles, more or less, away from the right place. However, he has gotten used to such troubles as these, and says very little. Indefinite orders is one of the trials of a country surveyor, which his city brother doubtless has a little to do with. Definite instructions by letter from those who understand what is required, and personal interviews by all others, would be a very satisfactory rule if always carried out, but this is impossible always, and so the trial goes on.

The evening before the day of survey is always spent in discussing the proposed work, and determining the best and quickest means to the end. Often the party or parties do not require that the surveyor shall make a survey that might set aside existing fence lines or points not at the present time in dispute, but only that he shall establish certain lines on the assumption that all

adjoining are correct. This is what is called a "conventional" survey, and it is just as legal as the survey made according to law, so far as the interested parties are concerned when they agree as to it.

Much time is often spent in locating the proper monuments or boundaries from which to commence the survey, it being the most important part of the work; and after they are all determined the balance of the survey is merely a proper application of geometry and mathematics, combined with such practical experience as the surveyor may have at his disposal for speed in the work.

The running of a trial line through bush or over rough ground for a mile or more is a common occurrence. Suppose the surveyor has to join the front and rear angles of both sides of a lot when such points are already marked with stakes, and he does not know the exact bearing of either line, he will then have to assume a bearing obtained as nearly as possible from his knowledge of the township lines, then run his line, say, one hundred chains, more or less, to the rear of the concession, and measure his error, and also the rear end of the lot; then return over the trial line, laying off the calculated offsets; then measure front of lot, which may be quite different from the rear, make calculation for true bearing of other side of lot, and run same from front to rear. This line should then split the stake in centre if there has been no local attraction, and all other allowances for compass variations have been made as the line is being run.

For rough, quick work the surveyor will always use his compass, which gives miraculous results in experienced hands.

There is a no more fruitful source for variety in descriptions of land than out in the country, for occasionally the surveyor will require to use his highest ingenuity to devise some new method in describing a parcel of land. Owing, of course, to various reasons, but the most frequent cause is that due to the owner wishing the surveyor to spend only one day in making the survey when he should have taken perhaps two; and the result is that the description will be either very indefinite in a few years to come, or else very cumbersome, and at least not as simple as it would be if sufficient time were taken in the first place to make the survey.

If there is anything that is mysterious about surveying in the eyes of the general public it is the fact that surveyors some-

times run lines by the stars. During such surveys you will sometimes hear men in the gang discussing the subject, and as their wonderment finds expression in words the more deeply they seem to become mystified. Now, if the surveyor's assistant happens to be along with him he generally adds a few words at the right moment, which seems to have the same effect upon them that is said to have been caused by an old surveyor who, while running lines with his compass, always used to walk around and around it with strange mutterings upon his lips, causing the onlookers to have a very superstitious belief in the results of his work.

Men sometimes ask the question, "What in the world have the stars got to do with my line fences that you need to spend time in looking at them?" And it often takes considerable explanation to show why it is so very necessary in many cases to proceed by that method, for the law requires that the line shall be run on the same astronomic bearing as the base line perhaps several miles away.

Often in running lines through thick bush for a mile and a quarter to join a point at the rear after running for about a mile, or perhaps only half a mile, some or all of the men you have with you will begin to impress upon you, if they can, their belief that you are running away across the lots, and perhaps even suggest that you go back and start over again. Some of these men are often old hunters, who have travelled through and through that bush all their lives, and know every foot of it, they will tell you; and they also know just where this line should be by certain old landmarks, considered as right by all, even if the line was never run by a surveyor before.

It is well to note the distances of these points from your line, and as you near the end you may have several points at various distances from your line. The men, of course, are always the first to reach the end of the line, and at once search about for the corner stake; and if you want them to put down a picket on your line at that point, if it happens to hit it exactly, or even close to it, they will sometimes pull up the picket again and set it very carefully off the line on some other point, as if that was the corner stake, and then wait to hear if you will say: "All right, boys; that's where the corner stake is." And thus they sometimes try to catch you if they can when they have been making such terrible assertions about your line running across the lots, when it has really come out exactly right. It is in just such cases

as these that the young surveyor is apt to become confused in his work and make mistakes, but experience soon teaches him to ignore all such talk and quietly attend to his own business. Still, he cannot help but feel a little anxious, if for nothing else than his own comfort, for all surveyors doing such work fully understand the peculiar sensations that arise as they near the end of long lines, and they learn to check very many times with care the angle they lay off with the meridian before commencing to run the line.

Country surveyors should fully understand the immense advantage in having the best of instruments, and in keeping them in perfect adjustment. Before commencing a survey in which there are long lines to be run he should always make a quick trial of the more important adjustments, and be particular to see that all screws work if anything a little on the stiff side, to prevent play between the parts, due to wear, which might not be detected in the ordinary process of adjustment.

Owing to the necessity of carrying instruments in buggies over rough roads sometimes the screws will loosen and cross-wires will shift; and if the surveyor does not note this fact he will, of course, find that his work does not come out as closely as it should. In city surveying the lines are generally short, and lighter transits will do the work quite accurately.

DISCUSSION.

The President—No doubt many of us have had similar experiences to Mr. Gibson in receiving letters from different parties, who want you to go to their place and run their lines without telling you where they are. In the part of the country I come from these letters are sometimes written in a foreign language, which adds a little to the confusion.

Mr. Wilkie—I have listened with a great deal of interest to the paper, and I can say that I have had similar experiences. I had a new one this month through a gentleman who ought to have known very much better, as he hailed from the city of New York. He wrote me, asking me to go prepared bringing all information to survey a lot in a certain township. He mentioned the township, but he did not mention the lot. He was a mining engineer, wishing to have a mining location surveyed.

Mr. Niven—People send word to you to go and run a line without specifying where. Only last week I went over into the County of Hastings; arrived there about nine o'clock in the evening; and I was to run a line the next day. It happened that the line was some distance away, about a mile into the woods, I think; and I had no chance of getting in there that night to get an observation; and the only thing I could do was to run a line in from a line I had previously run, as even if I waited another day the weather might change and be unfavorable for an observation, so I ran a line in from the other line. It turned out just as I expected: the night was not fit for an observation; but I had run my line into the point. Then they wanted to know why I had kept them working all day in order to get to that point—what benefit was it to them. Of course, I had a great deal of trouble in explaining to them, and I do not think I succeeded in removing the difficulty from their minds; but that is one of the trials we have in our practice.

The President—I think Mr. Gibson points out the advisability of surveyors in the country not limiting themselves to running lines, but taking all kinds of engineering work. As time goes on this, no doubt, will be necessary, more particularly in the older parts of the province, for there is a need for engineers in every township in the province where our work is now being done by carpenters and day laborers, and it should be carried out scientifically by men who have been trained to think and judge of such work as bridge building and drainage work, much of which will fall to the Ontario land surveyor in the future.

Mr. Speight—I have great pleasure in moving a vote of thanks to Mr. Gibson for his very interesting paper. I am sure we have all enjoyed it, and he has done well to emphasize the fact that he must conduct his business with probity and propriety if he wishes to be looked upon as doing his work in an ideal way.

Mr. Davis—I have much pleasure in seconding the motion. It has given me a great deal of pleasure to listen to the paper. If it shows anything, it shows that the country surveyor experiences greater difficulties than the city surveyor.

Mr. Gibson—It has been of very great interest to me to write this paper myself, for I think in studying a subject there is nothing better for us to do than to sit down with pen and ink in our hands and write about that subject; and you may write out several copies, but in the end you have got the subject down

fine, and you know all about it as far as you feel that you can from your knowledge, of the facts; whereas if you had not written it out, you would just have dim ideas of the subject. I find it a great help to write down what I like to know, and then I feel that I have got it all in a nutshell. And as for surveyors continuing their studies, there are a great many of us who make the mistake of discontinuing our studies after we get through. We should keep on in the work, and in that way we grow stronger in the estimation of those around us as to the opinions that we may give on the different subjects. It is a good thing to keep up with the times in reading the matter contained in scientific papers.

[This Association is not responsible as a body for the opinions expressed in its Papers by Authors.]

RAILWAY CURVES.

By H. STRANGE.

It is proposed to connect two tangents by a curve on a railway survey:

Given the angle of deflection=$2a$; in this case, 84 .

Secant—radius = b; in this case, 745 ft.

To find radius and tangent, call radius x, and the nat. tangent of $\angle$ at centre a; then tangent is ax; $b+x$ is the secant, and is also the hypothenuse of the right angled triangle comprised between secant, tangent and radius.

$(b + x)^2 - x^2 = a^2 x^2$ (Euc. 47) or $b^2 + 2bx + x^2 - x^2 = a^2 x^2$; eliminating the two x^2 (+ and −) it stands $b^2 + 2bx = a^2 x^2$ or $a^2 x^2 - 2bx = b^2$.

To expunge one of the unknown quantities, complete the square by adding to both sides of the equation $\frac{b^2}{a^2}$, which is the square of half the co-efficient of the second term divided by the co-efficient of the first term, and we have—

$$a^2 x^2 - 2bx + \frac{b^2}{a^2} = b^2 + \frac{b^2}{a^2}$$

and by taking the square root of both these equations we have

$$ax - \frac{b}{a} = \sqrt{b^2 + \frac{b^2}{a^2}} \therefore ax = \sqrt{b^2 + \frac{b^2}{a^2}} + \frac{b}{a} \text{ and } x = \frac{\sqrt{b^2 + \frac{b^2}{a^2}} + \frac{b}{a}}{a} \text{ or length of rad}$$

Formula x or radius is $\frac{\sqrt{b^2 + \frac{b^2}{a^2}} + \frac{b}{a}}{a}$

and radius multiplied by tang of angle at centre becomes tangent.

If we put this into figures as an illustration for the benefit of beginners, and carry it out into practice: Suppose $\angle$ of deflection is 84 : $\angle$ at centre, which governs all the calculations, is half that, or 42 : and to find length of tangent we must call that nat. tangent of 42 , or in this plan, a. The distance from the apex or junction of the two tangents along the line bisecting the $\angle$ included between the tangents (in this case call it 745 ft.),

where the stake on the curve to be cut, and is supposed to be on favorable ground for a railway, is planted; and it is required to find such point on the tangent from which to start the curve in chords of about 100 ft., of such degree of deflection for each chord that the last deflection which touches the tangent shall run exactly along the tangent without either cutting it or falling short of it. If the formula above is used with these figures, using .9 as the natural tangent of 42°, the tangent will be 1941, and that, divided by .9, is 2157, or radius. To run this curve with the transit we must find the degree of curvature for each chord, and the length of each chord, and that is done in this way: The number of degrees included in this curve is 84°, the < of deflection; and, of course, the length of each degree is found by multiplying twice the radius (1941 × 2) by 3.1416, the complete circle of a diameter of 1. That is, the whole circle is 13552.86, and, as a circle is 360°, this curve is $\frac{84}{360}$ of 13552.86, or 3162. As an engineer's chain is 100 feet, there will be 31 chords of 102 feet each, which will consume the whole 84° of the curve. Therefore, each chord will be a deflection of $\frac{84}{31}$ of a degree, or 2° 42′ 35″ which will be the < of deflection from one chord to the next. This applies to every chord but the first one, which, being a deflection from the tangent, must be only the half of what the others require. A pocket logarithm book should always be carried, or the nat. tang. of < at centre should be looked up at home, and the rest can be worked out in the *reldt*.

[*This Association is not responsible as a body for the opinions expressed in its Papers by Authors.*]

THE MINING OUTLOOK IN WESTERN ONTARIO.

By THOS. R. DEACON.

Resident Director Mikado Gold Mining Co.

Mr. President.—In dealing with the subject named above, before this meeting, I am perhaps going outside the lines of legitimate subjects to be discussed before an Association of Land Surveyors; but, as land surveying itself is becoming a lost art in this part of the world lately, and as I have never yet met a man, no matter what other trade, profession or calling he might pursue, who did not think, at least, that he was quite proficient in the art of mining, no doubt the subject would be considered appropriate anywhere. Two and a half years ago I had the honor to read a paper (a copy of which I present herewith) on the "Mining Industry of Western Ontario" before a convention held at Rat Portage, giving the results of my experience and observations up to that time, and expressing certain hopes for the future. Notwithstanding the many adverse circumstances against which the mining industry has had to contend, and notwithstanding the many foolish and absurd (not to say absolutely dishonest) enterprises that have been set afloat from time to time, I am very pleased to say that very real and substantial progress has been made in the establishment of a great and permanent industry in the district in the recovery and treatment of gold and other ores. I do not think that at any time in the history of the district has the prospect been so bright and the permanency of the industry so well established as at the present time. And this has not been accomplished by the blare of trumpets, nor by the discovery of the myriads of bonanzas which have been reported from week to week, each one greater in assay value and the veins wider and longer and richer than the one recorded the week before, but by the persistent and business-like procedure of seven or eight companies, who, having considered mining as a commercial enterprise, requiring the fulfilment of certain conditions as requisite to success, carefully selected properties upon which

the general conditions for a profitable enterprise, based upon both the scientific and commercial requirements, were most nearly obtained, went to work, and by the persistent continuance of systematic work, aided by a liberal expenditure of money, which is necessary in any business, have placed their mines in such a position that they are now yielding good profits and the permanency of the properties established. Each one has had its own peculiar problems worked out, and the general nature and individual characteristics of each carefully studied as the work of development progressed, till the owners have become possessed of the knowledge necessary to enable them to continue their operations, not as an experiment, but as stable enterprises. This is certainly making progress, and I am glad to say that there are at least seven or eight properties to-day in a position to work their mines at a profit with their present equipment, and a considerable number more which are being prepared for the actual work of producing bullion, not to say anything of the several score which are being prepared to work the public on the sale of stock, and who always take care never to arrive at the actual point of practical operations. Strange as it may seem, week after week we see new companies launched to operate on properties, the conditions of which are such as to doom them to failure in the very hour of their birth, and where it is amazing men can be found to supply the money, while at the same time many properties which seem to contain all the conditions essential for success seem going begging for development. The writer is aware of several good properties (in which he is not personally interested) which, in his humble opinion, are perhaps the equal of any properties yet operated, and yet they are lying idle for various reasons, chiefly because they have been handled in such a manner as to preclude the reasonable chances of their being fair investments, and so have remained undeveloped.

If I am asked what are the conditions necessary to success, I could only give my own personal opinion, which would, of course, be the result of my experience and observation, and may or may not be of value.

In the first place, as to the prospect itself. With the exception of one or two cases there has been no example to my knowledge in this district of a property having proved to be a permanent profitable gold-producing mine where the vein has not been in the immediate vicinity of the contact of granite or porphyritic granite with some of the Schistose rocks. It may be

right in the contact, it may be closely parallel to it, or it may cut across the contact; but the Sultana, Mikado, Regina, Foley, Golden Star and Hammond Reef are all either in the contact or close to it, and, though one of these mines is not at present running, it is no fault of the mine. I do not say that good veins may or do not exist under different conditions; in fact, I believe the Olive mine is not in a granite contact, but this seems to me to be the condition which gives generally the best promise of success. Having selected such a vein, the next step is to have it examined by a thoroughly good engineer of practical knowledge and experience in the district, and who is not given too much to run into a prodigality of figures as to what is under the ground, but who, by a large number of tests, by panning of skilfully selected samples, and also by assays has thoroughly demonstrated the presence of gold in the ore of a value of not less than $5.50 to $6 per ton. If the vein conforms to these requirements, then the next step is to arrange for the development of the property, either by contract or by placing it under the charge of a careful, competent man of business capacity and practical engineering experience in this district, and prepare to expend not less than $50,000 in sinking, drifting and connecting the levels by raises or winzes, and thoroughly acquiring full knowledge of all the various characteristics of the vein before any mill is built. The reason I say the man should have experience in this district is this: the conditions seem to be peculiar. Many men of undoubted ability and experience in other fields have come here, and some of them have frankly confessed that the conditions were so different from what they were accustomed to that they were all at sea, while others went right ahead on the assumption of mineralogical and geological conditions proving the same here as those they had been accustomed to in other mining regions, and the results were disastrous. They would not be apt to make the same mistakes over again, but it cost a good deal to their companies for their experience. When about two years' ore is provided for, an idea may be formed of how large a mill should be built, and naturally the larger the better, because the cost per ton decreases in the inverse ratio of the stamping capacity, the same number of firemen, engineers, amalgamators, etc., being required practically on a ten-stamp mill as a forty or fifty stamp, while the cost of management and transportation, etc., per ton is increased as the number of stamps are decreased. Until the mine is properly developed it is prac-

tically impossible to decide what capacity the mill should have, the nature of the treatment to be given the ore, or even the proper location of the mill, as the majority of the veins do not contain all pay ore, but have a broad, or narrow, as the case may be, band or chute of pay ore running through them, sometimes going down vertically and in other veins in a very flat incline. The position and dip of this ore chute will naturally determine to some extent the location of the mill, so that the cost of tramming will be reduced to a minimum. This, of course, is a question of mining engineering and practical common sense, but the study of the nature of the ore deposits and the becoming acquainted with their peculiar characteristics is a matter necessitating some years of close observation and careful investigation of the various conditions under which pay ore is found to exist, and the best means of obtaining the gold in the form of bullion so as to make the whole operation a successful commercial enterprise. The sum total of information respecting the ores in this district and the best methods of treating has been considerably augmented in the last couple of years, and after heavy expense the general nature of the machinery best adapted for the purpose has pretty well been decided upon; and I am now of the opinion that the industry is permanently established, and that one by one other paying mines will be added to those already in operation ; and this would appear to me to be making solid and substantial progress, and to promise well for the future. The Mikado mine has to-day more and better ore in sight in its stopes and drifts than at any time in its history. The monthly output has now risen to practically one thousand ounces per month, and gradually increasing, with larger ore reserves being opened up, while several of the other large mines are pursuing a policy of development, and exposing large bodies of ore for future use.

Careful and economical operation on right lines and on the right kind of property is as sure to bring success as any other kind of legitimate commercial investment.

DISCUSSION.

Mr. Sewell—Mr. Deacon's paper is a very interesting one. As it is associated with one of the principal mines in that locality, the Mikado mine, what he says would naturally have considerable weight. There are one or two points, however, which, I think,

need correction. He says that all the mines which have been turning out satisfactorily are at or near a contact. Now, I have been often over the district, and I know that that is not the case. The Mikado mine is in that position. The Adeline mine is in a similar position, but it is a little bit away; it may be a quarter of a mile away from it. The Foley, on the other hand, is right in intrusive ground. The Golden Star is likewise in the intrusive ground; and the Hammond Reef, another very important property, and perhaps the most promising mine in the country, and which I shall allude to later on in my paper, is nothing more than a Laurentian granite reef, and I might go on and quote quite a number of them which are not actual contact veins. The value of a contact vein is very great; there is no doubt about that; but still at the same time there are other properties which are equally good. I might say that I think myself that as a general rule the best discoveries so far seem to have occurred near centres of disturbance. You will notice that all those I have quoted are very near places which have been considerably disturbed at some period subsequent to their formation.

Mr. Campbell—I am inclined to think that some of the members have taken advantage of this Association to some extent to advertise themselves by writing upon matters which are not at all of direct interest to, or for the improvement of, the members of this Association; and it appears to me that before publishing these papers it would be well to have them submitted to the censorship of the Secretary, or some individual, who would go over them and have them practically re-edited before they are printed in the Proceedings of the Association. I do not see exactly why we should advertise any one mine here, or why any member should take advantage of his position for that purpose. Statements are being made which are not absolutely correct, and which have to be rectified by members present. No doubt a great deal of this information will get into the Proceedings, and be read by many without knowing what the facts are. We should be very careful in our papers to give only facts, and have all these facts vouched for as nearly as possible, and members should confine themselves to questions which pertain strictly to the business of the profession.

Mr. Dickson—I quite agree with what my friend, Mr. Campbell has said. I think this Association was formed for the purpose of promoting the interests of land surveyors above everything else. For a number of years we have had papers on mining

Now, I do not see what that has to do with the furthering of our profession at all. I quite agree with Mr. Campbell. It looks very much to me as if it were used as a way for advertising those particular mines.

Mr. Van Nostrand—I cannot agree with the sentiments of the last two speakers with regard to this paper in particular. It might be quite true of other papers read here. The charge has been made before, and perhaps justly so. In this case I cannot say that I think that this paper boomed any particular mine. It seems to me that seven or eight well-known mines are mentioned, and given equal prominence. Further than that, the writer of this paper is not the only one that has spoken about mining matters in the Rainy River district, and where the parties discussing it have the knowledge, any errors may be pointed out.

I think, too, with regard to the scope of our papers, if we limit them entirely to the running of side lines, which were spoken of yesterday, we may presently have no papers to publish. In this year's programme the greater number of the papers refer to land surveying, a few of them are on engineering work, which is quite foreign to land surveying; and yet we are very glad to get those papers. We are not considering the profession alone, but we are considering the individual members of the Association, whose practice covers a large area. We have also to consider our exchanges. We send our Reports to our brethren across the border, who are not in as fortunate a position as we are with regard to land surveying, and we think we have been helpful to them in showing that land surveying may be brought to a higher standard than they have. Some of the land surveyors in this city are engineering men in their practice. There are a great many points to be considered in selecting papers for a programme, and so we allow into our programme papers that do not relate directly to land surveying.

With regard to this paper itself, it is open for every member to discuss it; and if any member desires to introduce a resolution setting forth that this paper shall be received and printed in the Proceedings, I think that is the fairest way to get the general opinion; otherwise it is left to one or two comparatively obscure individuals to exercise their censorship.

Mr. Campbell—Do not understand me as criticizing the propriety of the programme. I think the programme is very well prepared. I think we should have a diversity of papers; but I do think that some writers take advantage of the situation, and

use their position for the purpose of advertising their business or going outside of the profession in discussing matters.

The President—I think Mr. Campbell did not hear all the paper. The writer gives his opinion on this matter, of good profitable mineral occurring in the contact and away from the contact; and I think he is very fair in what he states, and is not at all booming any one particular mine. He says: "I do not say that good veins may not or do not exist under different conditions; in fact, I believe the Olive mine is not in a granite contact, but it seems to me to be the vein which gives generally the best promise of success."

I think Mr. Deacon's paper a valuable one, and it is fortunate that we can have a paper from one in his position, one of confidence in a large and profitable mine. It seems to me it carries a great deal more with it than a paper from some one who had only a superficial knowledge of the question. At the same time no doubt there is something in what Mr. Campbell said, that some of our papers in the past have not been as sincere as they ought to have been, although I do not think we have had many cases of violation of the rule, that a paper should be of general interest. But in the future as our Association grows we probably ought to have a committee to revise the papers. I think myself that fewer papers and more discussion would be better for the Association. In the Canadian Society of Civil Engineers a great deal of importance is laid upon the proper discussion of the papers; and we are always hurried in our annual meetings, and there is not sufficient time to discuss the papers, because as a rule we have too many. If we were to have fewer papers and a better discussion we would have a more interesting Report, if that were possible, than we have at present.

Mr. Van Nostrand—Before passing to the next item of business we should acknowledge Mr. Deacon's paper in some way. It is usual to have a motion to receive and have the papers printed. I have much pleasure in moving that Mr. Deacon's paper be received and printed in the Proceedings.

Mr. H. H. Gibson—I have much pleasure in seconding this motion.

The President—I think upon reading the paper all will find that there is nothing unreasonable in it. Carried unanimously.

[This Association is not responsible as a body for the opinions expressed in its Papers by Authors.]

BACTERIAL FILTERATION.

By E. G. BARROW.
Hamilton.

Of the various methods or processes devised for the purification of sewage the system of rapid filteration (which utilizes minute organisms or bacteria as agents for the destruction of the impurities in sewage) is fast coming to the front as one of the most effective and economical to operate. The purification of the sewage is brought about by the bacteria contained in the filter beds, which are constructed in such a way as to promote the activities of the bacteria, and provide a home, as it were, in which they can carry on their operations in a more perfect manner than is done in the natural soil.

The advantages claimed for this system of sewage purification are, that only a small amount of land is required compared with a sewage farm, that no expensive machinery is needed for pressing the sludge, and that a very pure effluent is produced, which can with safety be discharged into any stream, river or body of water. In large manufacturing cities it may be found advisable to first subject the sewage to a preliminary precipitation in tanks before sending it forward to the filters, but for ordinary domestic sewage, or that which finds its way into the sewers from dwelling houses, this is not necessary. Bacterial or bacteryolitic filter beds are of two kinds—the coarse and fine—the sewage being first admitted to the coarse or roughing filter, and then passing to one or more fine filters. Both of these beds are necessary for complete purification. The sewage is sometimes admitted at the bottom of the coarse filter, from whence it passes upward, and is then conveyed to the fine beds—in this case two or three inches of water remain on the top of the coarse bed. When this plan is adopted no scum forms on the top of the bed, which is the case when the raw sewage is run on to the top of the filter. The office of the roughing bed is the straining and liquefaction of the sludge and partial purification of the

sewage. The aerobic or fine beds are the home of the nitrifying bacteria, and the effluent issues from this, freed from most of the organic impurities in solution, and thoroughly mineralized. Bacterial beds have been constructed of different materials and of various depths. Experience has proved, however, that rough materials, such as coke, coal, cinders, slag, burnt ballast, etc., are the best. Experiments made by passing sewage through glass balls and other smooth bodies demonstrated that very slight purification had been effected. The size of filtering material should be, for the coarse bed, that which will pass through a two-inch ring and be rejected by half-inch screen. For the fine bed, that which will pass a screen of three-eighths or one-quarter inches, and be rejected by one having a mesh of one-sixteenth of an inch. In order to get the best results from these filter beds the sewage should, after it has filled the bed, be allowed at least two hours rest, after which it is allowed to run off and then before the sewage is again permitted to fill the filter a period of from two to three hours aeration must be given, in which the interstices in the filter become thoroughly filled with air.

If the ground at the site of the works is of clay or other impervious material it will not be necessary to use brick or stone walls, and the walls or sides can be made of earth thrown up from the excavation—the bottom of the filter beds, however, will have to be above the nearest stream or body of water into which they are intended to discharge. There is no necessity to use tile drains for the bottom of the fine filter beds as coarse material will do just as well, such as broken stone or coarse gravel, and I think several small discharge pipes through the sides are preferable to one large one. The admission and discharge of the sewage may be regulated by machinery working automatically, but my opinion is that an intelligent man to oversee these operations is more desirable. One cubic yard of filtering material should be provided for every eighty-five gallons of sewage delivered in twenty-four hours. This is at the rate of about 400,000 gallons per acre where the filter is three feet deep. If the filter is increased in depth this area may be reduced. Thus if the filter be made four to six feet deep the rate of filteration can be at the rate of 600,000 gallons per acre. It is necessary to have two or more filtering beds so as to permit of the filling, resting, emptying and aerating processes. For a small plant and where economy has to be exercised a saving on first cost will be made by adopting only a few beds, but

experience points rather in favor of a number of small beds. It will be understood that the amount of filtering material will be the same for a given sewage flow and that the number of beds represent so many divisions of the material and consequently a greater number of fillings of the filter during a certain fixed period.

The size of the coarse and fine beds on works already constructed and in operation appear to be nearly the same, so that so far as dimensions are concerned they may be a duplicate of the fine beds

I had, at our works in Hamilton, a small experimental filter constructed in rather a novel way. It was made of tongued and grooved lumber, braced with iron rods, about thirty feet long and twelve feet wide, divided into two nearly equal compartments. The raw sewage entered at the bottom of the first compartment whence it ascended to the top, filling the compartment —it was then conveyed and distributed by perforated troughs over the surface of the second compartment. The material of the last compartment was two feet below that of the first so that there was a distance of two feet through which the sewage dripped in a fine spray. This was allowed to run for three months without being touched and the effluent was clear and of very good quality.

The first compartment was filled, first, with old broken pieces of sewer pipe, about a foot; then there came slag from the Smelting Works, about two feet, and lastly coarse coke. The next compartment was composed of fine coke, one foot, then one foot of fine coal then one foot of coke, and at the bottom a layer of very coarse gravel. The rate of filteration was about 600,000 gallons per acre. I believe the two feet drip of the sewage in fine spray had a very beneficial effect.

This filter was run for a month during the winter, and the sewage in the first compartment did not freeze, but icicles formed where the sewage dripped through the perforated holes in the wooden distributing boards, so that I had to discontinue the operations.

It is believed that when the sewage enters the filter at the bottom it is acted upon by anaerobic bacteria similar to those which liquefy the sewage in a septic tank, but the effluent is certainly not in such a putrefactive state as that from the septic tank, which latter is most offensive. The effluent from a septic tank must, of course, be passed through a filter to complete its

purification. Thus the roughing filter and the septic tank are each used as a means of breaking up or liquefying the organic matter in suspension in the sewage, and preparing it for application for the fine or aerobic filter, which would soon become clogged if the raw sewage were put on it without its having been acted upon in the septic tank or rough filter; moreover it is in a condition favorable for the action of the nitrifying bacteria contained in the fine bed. The rate of filteration in some works has been greater than that already stated, but it is not well to tax the beds to their utmost capacity. Before the sewage is conducted to the filter beds it should be passed through a detritus chamber and screen, where paper, rags and other large substances will be arrested. The pipe or conduit leading the sewage from the detritus chamber to the filter beds should enter the chamber a foot or so below the surface of the water in the chamber so that the grease will collect above the sewage passing to the beds. The grease can then be skimmed off. If the separate system is in use, no provision need be made for storm water. If the combined system of sewerage exists, then provision should be made for at least the first part of a storm. No injury, however, is done to the beds by allowing the storm water to pass through.

If time permitted I could have said a great deal more on this important subject, but I trust I have said enough to interest many of those present, and to direct their attention to a method of sewage purification which appears to me destined to become one of the most satisfactory and popular methods yet devised for the purification of sewage.

DISCUSSION.

Mr. Van Buskirk—I have just read a paper by Mr. Barrow on an experimental bacterial filter plant that he has erected. He does not give us the degree or anything like that, but he states that so far as he has gone with his small filter he has got a very good result. The filters are constructed on what is known as the English system of bacterial filters.

The President—Mr. Barrow makes this statement in his paper: "Thus the rough filter and the septic tank are each used as a means of breaking up or liquefying the organic matter in the sewage, and preparing it for application in the fine filter,

which would soon become clogged if the raw sewage was put on without its having been acted upon in the septic tank or in the rough filter."

About a month ago at a very cold time when the thermometer was below zero for several days, in company with a number of other members of the Canadian Society of Civil Engineers I visited the sewage filter beds at Brigden, Mass. This is one of the most perfect sewage disposal plants in America, and operating under conditions similar to those that we have in Ontario, the western part of Ontario at least. In Brigden the sewage is received into a tank that will hold sewage for at least a day. It is dumped out to filter beds in a gravelly location where the soil is gravel. First, the surface soil and the subsoil has been removed down to the gravel and sand. They have twenty-three beds of an acre each, and they pump out the sewage direct from the tank to these beds. They have found that this tank acts to a certain extent as a septic tank, although it was built before that principle was recognized. We walked all over the beds. They are perfectly clean; all that is required is to rake them in the summer time, I think, once a month or something like that. Of course, they have a large area and a comparatively small amount of sewage. The city has 40,000 inhabitants, but the amount of sewage is only 600,000 gallons. They have a good water supply, and nine-tenths of their service is metre, so that the quantity of water used per head is only thirty gallons per day, and the amount of sewage, as they have the separate system is comparatively small, being 600,000 gallons per day, as I have said before. And there they get perfect results, as shown by the chemist that they have employed in the little laboratory on the farm, who is making continuous experiments. The drains are down about eight feet below the surface, and the sewage is filtered through these eight feet of gravel, which ranges from about the size of a pea down to very fine sand.

The City Engineer told us that he might put in a septic tank as a kind of experiment to obviate the necessity of raking their beds as often as they do now. Labor there is very expensive, and if they can do that they will save a lot of money. But their system is perfect. The matter is colorless and odorless, and upon opening some bottles of it that had been there for twenty-seven hours there was not the slightest odor coming from the bottle.

Mr. E. S. Gibson—What about the atmosphere?

The President—There is no apparent odor except right where

the sewage was coming out. The sewage being warm, and it being a very cold day, there was a litle vapor arising, and that had a smell. This is not for rubbish; this is for ordinary house sewage. They have very little other than house sewage. I am told it makes all the difference in the world whether the sewage is house sewage, or whether it is contaminated by manufacturing waste.

Dr. Bryce—The principles underlying the septic tank system are known to us all. I presume most of us are surprised that we know so much about it. All of us know perfectly well that if we put half a foot or eight inches of manure on the garden in the springtime there is not any manure to be found after two or three months. Possibly it has not occurred to us why this is so. Now, it is exactly the process that goes on there which underlies the whole question of the disposal of sewage by what we call bacteriolysis. If any of you will go over to the laboratory where Dr. Mackenzie works you will at once see the reason for it. You take any solution—it does not matter whether it is beef broth, sugar or gelatine, and you add a few bacteria to it; and some of them will grow freely on the surface of the solution, and some will not grow on the surface. They will grow in the centre of that gelatine; and day by day they will cause it when solid to gradually liquefy. It is a curious phenomenon, but any of you will understand it in a moment. Just to illustrate: Suppose that certain bacteria will live and multiply, taking their oxygen from the substance they live in, while others, living on the surface of the gelatine, take their oxygen readily from the air. It is now thirty years since Pasteur found it out. He found out that if he wanted to grow the yeast plant in beer work he must let any amount of oxygen be present to assist in the work. If you want to grow alcohol, or the germs which change the sugar into alcohol, keep the room saturated with carbonic acid and limit the oxygen. The germs will then do the work by taking the oxygen from the sugar and changing the sugar into alcohol and carbonic acid; in other words, much oxygen, little alcohol; less oxygen, more alcohol.

Now, in what we call the septic tank the sewage goes in and gets away from light and air and all forms of aerobic bacteria and anaerobic bacteria are carried in with the sewage from the sewer. Both of them are at work, some of them utilizing the free oxygen. The principle has been carried out in some sewage plants in the province. With carbonic acid and little oxygen

present the anaerobes grow, decomposing the sewage and utilizing its oxygen and making carbonic acid on the one hand, while the hydrogen goes over and makes ammonia and sulphate of ammonia. You have got all your gases, ammonia, carbonic acid and sulphides formed.

Now, here is what is the basis of our modern septic system as the result of experiment. Mr. Scott Moncrieff seven years ago constructed in his private residence a little filter of this sort. He simply had a tank and deposited his sewage in it. The plan of this tank is published in the Report of the Provincial Board of Health for 1898. He carried the fluid sewage from the septic tank over on to a series of coke filters about the size of a pea, arranged one over the other, and tried to see what the result was, and found that in twenty minutes sewage loaded with ammonia falling on the first filter had become changed to a nitrate by the time it went through the sixth filter. It appeared that different bacteria did different work in the several filters, there being always free oxygen present. If any of you remember your old chemistry, you have your NH_3. You can replace the hydrogen by HO, which is the molecule for it, and that gives you nitrous oxide gas. You can, if you like, replace two other atoms by one of oxygen; and thus if you go to the end of the oxidation you have got nitric acid. Your ammonia has been changed in these filters inside of half an hour from ammonia as it came from the septic tank to food for plants as nitrates. Down in the bottom you only have to have present lime or potash in order to give your nitre, or nitrate of potash or ammonium chloride so much, nitrous oxide so much, thus using up almost the total amount of ammonia. The nitrogen present has thus been all converted, and such is the process that goes on in what we call our sand filter or our nitrification filter on the larger scale, or the coke filter. Dr. Louis Woodhead found that in the first tank of the number of microbes in any given centimetre of sewage about three-fifths were anaerobes, the balance being aerobes, which break up the sewage in presence of free air.

The whole question, then, is a biological one of keeping out of your sewage such substances as the creosalt of gas liquors and such as come from tanneries, which may contain a certain amount of arsenic, such as might possibly do injury by their presence in preventing nitrification going on.

The whole problem has brought us back right to where we started, namely, the processes which go on in Nature's labora-

tory, which we are only trying to imitate, and, if possible, assist and make more useful.

Mr. Van Buskirk—From some remarks I heard yesterday and to-day I think perhaps it would be as well for us to consider where we are. A young man read a paper yesterday on the subject of the "Country Surveyor," and pictured him as an authority on all scientific matters. Then, again, to-day I notice some objections to some papers which are not of a surveying character. In order that we may grow old and grey-headed it seems to me that we must keep up with the procession; we must know all about what is going on around us in a scientific way; and it would be very surprising, no doubt, to know that many of the farmers around us know a great deal more about such questions as Dr. Bryce has been discussing than nine out of ten of the surveyors and engineers; and I think we cannot do better than study such questions as a society. If we do not, the Society in a very short time will have its headquarters somewhere around Hudson's Bay and not in Toronto. We have got to keep up with the procession; consequently I am very much pleased to see papers of the character that Mr. Barrow has presented to the Association. I go in for this myself, but I have always read up engineering subjects. I read a paper on the same subject, and I made some experiments which I stated in that paper were bound to come before the public in a very short time as the best method of sewage disposal. Well, they have come forward, and Mr. Barrow is now writing a paper on it. The Society as a whole is not writing on it as shown by these proceedings, but none of us can afford to get behind in the race for money. We must know as much if not more than the people around us on scientific subjects in order to grow old and grey haired and be carried to the grave by the greater part of the township.

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BLAZED TREES.

By JOHN DAVIS.

Alton.

Life has been referred to under a variety of terms. It is spoken of in Holy Writ as a "fight." Longfellow speaks of the "Bivouac of Life," Shakespeare speaks of it as "a play," and Addison in his "Vision of Mirza" calls it "a dream." Surely, then, as a surveyor I may be pardoned if I refer to it as a "line" over which I have been taking a backward look. Extending, as this "line" does, over a period of twenty-five years, many portions of it are indistinct, and are barely discernible over the long stretches across which it has been drawn, extending, as it does, from the barren lands of Newfoundland to the fertile plains of the great Canadian North-west.

But although it may in places be indistinct, here and there bright spots appear, which shine out sharply and distinctly. They are the blazed trees I am going to call your attention to, by means of which memory is able to trace it through the tangled forest, over the fragrant meadow and by the shady stream. They represent little incidents and episodes—trivial in themselves, perhaps—yet serving to brighten the pathway and refresh the memory of him who attempts to retrace this line to-day. The incidents they represent are varied in character. There are the grave as well as the gay. Some are tinged with sadness, while others abound in gladness. Some are on the flinty face of the spreading beech, others are on the soft cheek of the sighing pine; but all join in telling their sweet story of a past gone forever. I cannot tell you of all those blazed trees. I can only refer to a few that stand out a little more prominently than the rest, and by whose sides the line passed in very close proximity. The first I must speak of is my connection with the kindly old gentleman, the late Charles J. Wheelock, of Orangeville, with whom it was my privilege to serve my apprenticeship. Divested of the halo which time has since thrown around him, I can still see him as

one of the most gifted men with whom it has been my lot to be associated. He was truly the youngest old man I ever saw, and had a fund of wit and humor that seemed inexhaustible. He had a great love for his chosen profession, and a keen appreciation of all that was good and true in his surroundings. He was an ardent lover of nature, and admired her in whatever mood she presented herself. To know him intimately was a liberal education in itself. He was quick to appreciate a joke, and was a perfect storehouse of humorous anecdotes. Sitting in the Wellington Hotel in Guelph with him on one occasion he was accosted by a brother surveyor, the late F. J. Chadwick, who said to him, "Say, Wheelock! Are you a Freemason?" "No," said he; "I charge for my work." Whether he was facing winter's coldest blasts or sweltering under the hottest summer sun he invariably wore a high silk hat, and it was often the cause of much inconvenience to him, especially when pushing his way through thick swamps. In a farmhouse on one occasion he placed it on the floor beside his chair, where it was subsequently utilized as a seat by one of the children. He presented a most ludicrous appearance with it on his head in its damaged condition for several days thereafter till he got home. It looked for all the world like the bellows of an old concertina, and was the means of almost sending several people into convulsions with laughter.

Said he to me as I sat by his bedside only a day or so before his decease, when he was so exhausted as to be scarcely able to speak, "I'm on my last legs, John. Well, I'm not exactly on them either." And then after a brief pause said he, "I'm like Mrs. Partington. I'll soon scuffle off this mortal soil." He was a poet of no mean order, and had he chosen to allow the productions of his pen to be published, would have made his mark in that direction. The following incident will show what he could do along that line on the briefest possible notice. We had just finished a preliminary survey of the Arthur Junction Railway. Our office work had been performed in a room also occupied by a sewing machine agent. As I packed up my effects preparatory to leaving for home I came across an old pair of boots that had become unfit for further service. These I decided to leave in the office, and, placing them side by side on top of a sewing machine, I wrote a few verses, giving vent to my feelings at thus parting with my old friends, and pinned the scrap of paper on which they were written on the leg of one of the boots. I have forgotten the verses. I recollect, however, that they were execrable speci-

mens, and exactly such as I might be expected to produce. Shortly afterwards Mr. Wheelock came in and read my effusion; then sitting down, facing the boots, he wrote the following lines, and attached the manuscript to the other boot, where I found it some weeks afterward on revisiting the office:

"A BOOTLESS TASK."

"Alack aday! Och, philaleu!
My heart is tinged with sorrow's hue;
To see you stand like empty kegs
"As stiff as pork," your feet and legs
So full of wrinkles, seams, and dints,
That one would think you had the splints.
Dear old *cow* hides—Adieu! *a due!*
My two poor *calves* are missing you;
How oft have you in former days
Upheld my feet in slippery ways,
And did my every step control
Staunch guardians of my wandering *sole!*
In rugged paths you led me through,
And helped my *understanding*, too.
I grieve to see you torn and tattered,
Begrimed with muck, and mud bespattered;
But for your use in by-gone time
Your name shall shine in jingling rhyme;
On Phœbus wings your fame shall ride
To old Parnassus' mountain side,
The muses shall with you condole,
And "lay sweet unction to your *sole*"
May set up one in state to look at,
And of the other make a bucket
To dip in pure Castilian springs,
Where oft they lave their joyous wings,
Or guild you with Pierian dye,
And make you shine like Juno's eye;
Give you a niche among the stars
With Venus or with shining Mars,
And by their fiat treat creation
To one more brilliant constellation;
Perhaps two "Fish" with glittering fins,
Perhaps—another pair of "*Twins*,"
Whilst all the spheres around our earth
Shall hold rejoicings at their birth,
Producing ample proof, indeed,
Of strength in old Dame Nature's seed
To give a pair of stellar dears
To gladden the celestial spheres,
And shed for us a *boot*-eous light
When all our lamps are out at night,
Perchance the astronomic clan
May see two "Bootes" instead of one,
Or, haply, some of them may bore us

With having found another "Taurus,"
The legs would make right lusty horns;
The head, the part that pinched my corns;
The tail—I own I cannot place it
So let imagination trace it;
But whether "Fish," "Boot's, "Bull" or "Twins,"
"It matters not a row of pins"
They'll dub you a bright constellation,
And sound your fame throughout the nation
With caustic wranglings and disputes,
Won't that be honor for my boots?

AN ARTHUR TOWNSHIP BLAZED TREE.

The next blazed tree refers to an incident that occurred in the Township of Arthur. I was standing on a fence holding a picket on the line which passed between a farmer's house and barn, when a very red-faced old man came to the back door and shouted, "What are you doing there?" His tone was so exasperating that to tease him, I replied that we were running a railway line. At this I heard his wife cry out, "Hunt them, Peter!" No more was said at the time, and I passed on with my picket. Seven years after while practising in Guelph I received a telegram asking me to come to Arthur Township and run a line for one Peter Campbell. I was met at Arthur village on my arrival there by a young man, who drove me out to the farm, and as we passed up a long lane towards a small log-house it suddenly occurred to me that this looked wonderfully like the place where the old couple had accosted me on the occasion referred to. "I wonder if those two old people are alive yet," said I to myself. On reaching the house, however, all doubts were speedily set at rest, so far as the old man was concerned at least, for there he stood at the gate; and not looking a day older either. He showed me in; and thankful was I that he showed no signs of recognition. But I felt far from safe though, for I had the old lady to deal with still. The house was one of a class common to the newer settlements, and with which nearly every surveyor is familiar. There was one large room, with two small bedrooms adjoining, separated from it by a board partition extending across the house. Entering the large room by the front door, I took a seat close beside it and awaited developments. In a few minutes in came the old lady, and took a seat directly opposite me. We chatted about the weather, the crops and other topics, but all the while she kept her eye on me in a manner that I thought boded trouble for me in the near future. I was resolved to say

nothing about the affair of seven years before unless she knew me to be the guilty party. I fancy I can see her yet as she sat there before me, her broad face wreathed in a smile that seemed to plainly say, "I know you, my lad." At last she blandly enquired if I had ever been in those parts before. I knew I was done for then, for there was a twinkle in her eye that unmistakably meant mischief. Having regard to the answer I had so pertly given them on the occasion of the first interview, I think she fully expected me to come out with a flat denial. I tried an equivocal answer, however, and replied that perhaps I had been there before; that a person knocking round the country as I had been for so many years might possibly have been there before. Looking me square in the eye, she said, "Were you not out here on our fence some years ago with a flag-pole?" and pointing with her thumb over her shoulder towards the back door. I could keep a straight face no longer, and made a clean breast of the whole affair, complimenting her on her wonderful memory for faces in thus being able to recognize a complete stranger after such a lapse of time. We had a good laugh over it. Good souls! they have both passed over the river since then. Our hearts go out to them in grateful sympathy. They belong to a class rapidly passing away. They went forth into the wilderness "with tears," "sowing precious seed," whilst we who survive them are reaping the fruits of their toil and "bringing in our sheaves with rejoicing."

A ROCKY MOUNTAIN BLAZED TREE.

Shortly after locating in the City of Guelph, twenty-one years ago, I received a telegram which read as follows "meet me tomorrow to do survey at the Rocky Mountain." The last two words were so suggestive of the famous backbone of the North American Continent that I was a little staggered at first, but my neighbor, an insurance agent with a better knowledge of the surrounding country than mine informed me that it was situated a few miles north of the village of Fergus on the Owen Sound road. I was duly on hand next day, and was met by an old gentleman who owned the property I was to make a survey of. On it stood a small log building which in bygone days had been a hotel—The Rocky Mountain Hotel by name. I finished the survey that evening and had to wait till next morning for the arrival of the stage to convey me to Fergus. The old gentleman

and I secured lodgings for the night at this old hotel and the evening was agreeably spent in listening to the tales he told me of the glories of the good old days when whiskey was cheap and flowed freely. He told me of the long strings of loaded teams that came down from the far north and whose drivers made things "hum" round the Rocky Mountain, on their return trips. He heaved many a sigh over the glories of those days that preceded the railway which had knocked the life out of scores of such hotels and left them sitting disconsolate by the roadsides. The hour for retiring having arrived I found that there was but one spare bed in the house and we were to occupy it. I went upstairs first and crawled in near the wall and was soon joined by the old man. He told me that one of his lungs had disappeared entirely and that the other was in a very bad condition. He had a dreadful cough, which increased in intensity after he had been in bed a short time. The cough in itself was very annoying to both of us, but there was something else that annoyed me still more. Every time he coughed he spat out into the inky darkness of the room with a vigor that surprised me considering his solitary lung. This had not gone on long till I began wondering where the several articles of my wearing apparel were located. I ran over in my mind where each had been placed, and concluded that all were out of range except my socks, which had been left on the floor. After this I spent a most anxious time. If I heard the spit strike the floor I concluded he had missed the mark, but when it fell as softly and noiselessly as the gentle snowflake on the bosom of the frozen earth, I knew he had made a bullseye. Thus passed a never to be forgotten night and if it has had no other effect it has had this, that to this day I cannot leave my socks on the floor when I retire, even if I am the sole occupant of the room. I have thus learned to treat them with a degree of respect to which they were utter strangers in my younger days.

A ROCKSIDE BLAZED TREE.

I was once engaged in running some farm lines near the small village of Rockside, in the Township of Caledon. An important stake could not be found, but I heard of an old settler of whom it was said that he could tell where it had stood. On driving to his place I found that he was assisting a neighbor, in whose barn a threshing machine was at work. Thither in turn I repaired, and enquired of the boss of the threshing machine

gang where I could find him. He told me that he was in the rear of the barn working at straw, and that if I followed him he would point him out to me. I struck into the barn after him through a perfect mist of black dust. As I threaded my way through the thick atmosphere laden with the perfume of mint and other aromatic weeds, past the busy machine, and listened to its sullen roar, my mind went swiftly back to my boyhood days on the farm, and the sport we used to have when threshing days came round, and how at the close of the day we did ample justice to the apple and pumpkin pies and other good things that the farmers' wives so well know how to prepare. My reverie, however, was but of short duration, for my guide was hustling on ahead, and I had to keep him in sight. He passed round to the rear of the machine, and crossed over to the other side under the revolving wooden slats that were passing downward from the strawstack, after having duly deposited their load of straw at the top. I thought he made more of a detour than was absolutely necessary, and concluded to cut across a little nearer to the machine, over a pile of chaff that was slowly accumulating. Little did I think of the pitfalls that lay in my path. Ducking my head and shrugging my shoulders to keep out the dust and chaff blown out by the machine, I made a dash for the other side, when suddenly the floor of the barn seemed to give way beneath my feet, and I was engaged in a desperate struggle to keep from passing through to regions unknown. I had walked squarely into a large opening in the barn floor, used for letting the chaff pass through to the basement below. Had I simply allowed myself to pass through to the cellar at first I would have fared better, for the height could not have been more than ten or twelve feet, but in the confusion of the moment I fancied I might have to drop thirty or forty feet, and decided to hang on and struggle out if I could. On finding myself sinking I involuntarily threw out my arms to grasp something, but the yielding pile of chaff that surrounded me afforded but a poor hold, and I had gone through so far that my head was lower than the summit of the pile; and to make matters worse my hat had gone through, and the machine was mercilessly sifting chaff on my bare head and down my neck. Mouth, eyes and ears were full of it. After an interval of struggling that seemed an eternity, and a horrible feeling of suffocation that filled me with gloom and black despair, I at last succeeded in getting up on the barn floor. How I ever did it I cannot tell to this day. On reaching

the floor, the first sight that met my bewildered gaze was that of my guide, who, utterly unable to stand, had sat down on the barn floor to laugh. He had laughed till the operation was actually painful. Rising, and still holding his sides, he came forward and tried to apologize for not having informed me of the presence of the hole, but a fit of laughter again supervening, he had to leave me and have it out. I then went round the barn to look up my hat in the basement below, and there lying on his back in the chaff was another individual, indulging in more than moderate merriment, who had been an eye-witness of my frantic struggles from below. I learned afterwards that at the supper table the wildest of hilarity prevailed as these fellows graphically described what they had been eye-witnesses of.

I desire in closing to express the regret I feel that through neglect on the part of the older members of our profession vast stores of interesting experiences have been allowed to slip from us and fade away into the insatiable past. Our surveyors have passed to and fro in the land, doing well their work; but how little of their inner lives has been revealed to us! They have staked out their boundaries, and left their technical records in description thereof, but how little they have told us of the real lines of life that they ran, and of the "Blazed Trees" that stud the way. I would, therefore, earnestly urge every land surveyor to pause once in a while and take a backward look over the line of life that he has been running, noting well the "Blazed Trees," and making a record thereof, that may be handed down to his successors, knowing well that such records will be appreciated by them as something of paramount importance and interest.

DISCUSSION.

Mr. Niven—When I saw the paper, "Blazed Trees," on the programme I expected to hear a different paper. However, it has been very interesting and amusing. With reference to the principal character, Mr. Wheelock I may say that I met him many years ago; in fact, the first year I was a pupil with Mr. Passmore, Mr. Wheelock had not been out long from Ireland, and I remember him as a very genial kind of man; in fact, the pupils in the office were always very glad to see him. He always carried with him an immense big transit with two telescopes; and

he would always say that he never felt right unless he had it on his back. I know Mr. Wheelock was in Orangeville as long ago as 1857, and he remained there until his death. I saw him four or five years ago. I remember him very well.

The President—This contribution to our Proceedings, gentlemen, I am sure, will be a very charming one to have printed in our Report. We were not aware that we had a member with such literary attainments as our friend, Mr. Davis, and I hope he will be able to turn them to good account in the future. I shall be glad to receive a motion of a vote of thanks to Mr. Davis for the paper, which is of more than ordinary interest.

Mr. Niven—I move that a vote of thanks be given to Mr. Davis for his paper. It is a little out of the general run of surveying papers, but it is very interesting all the same.

Mr. H. H. Gibson—I take great pleasure in seconding this motion. I was thinking while it was being read that it might be a continuation of my paper—it follows so much on the same lines; but he entered into somewhat different details from what I did.

Mr. Davis—I am sure I feel very thankful, gentlemen, for the flattering vote of thanks you have accorded me. The only object I had in writing this paper was to give information, and, if possible, draw out some more papers of this class. There is nothing that is so interesting to the average individual as reminiscences that are met with in practice; and who is there who has a more general round of interesting experiences than the surveyor. They meet people under all phases of existence, and they have opportunities of observing life in a variety of ways that ordinary men have not, and yet how little we hear of these experiences.

[*This Association is not responsible as a body for the opinions expressed in its Papers by Authors.*]

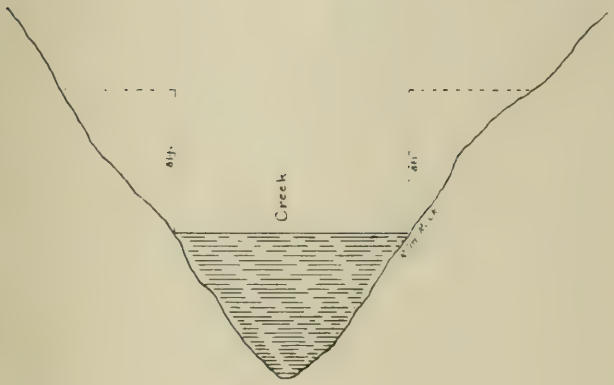
MINING REGULATIONS (YUKON).

By T. FAWCETT.

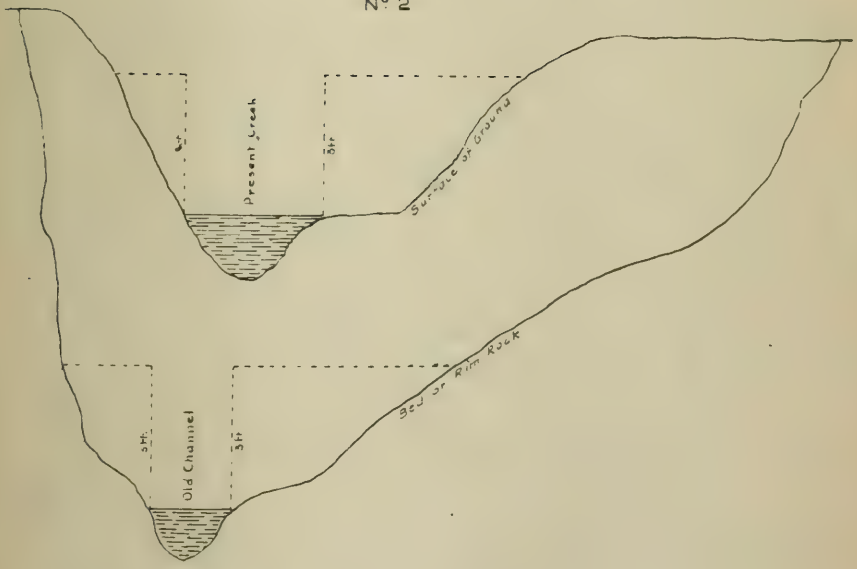
Mr. Fawcett prefaced the reading of his paper by saying that: "If this paper had been read a year and a half ago it would have been more interesting than now; but as some of the gentlemen present were there last season they will understand the points I have mentioned on the work of the surveyor.

Mr. President and Gentlemen,—In bringing this paper before you I do so with some hesitation, because it may not seem judicious to publicly point out or criticize measures and laws which have been recommended by other members of this Association, members of high standing, whose opinions are taken almost as authority, not only in many questions of law, but also in questions which are more particularly interesting to the surveyor.

It became necessary for the writer, when appointed to the office of Gold Commissioner of the Yukon territory three years ago, to make a particular study of the regulations governing placer mining in that country. The regulations which had been adopted by order-in-council to govern the disposal of mineral lands in the North-West Territories had previous to that time been amended in the direction of allowing a larger claim in the Yukon Territory than was allowable in the North-West; the other sections remained the same. In the spring of 1897 a code of laws was drawn up and adopted for the Yukon territory, which contained little more than an abridgement of those which had been in force before. It was early seen that there was difficulty ahead of the surveyor who might be called upon to survey the creek or gulch claims which at that time were defined as extending 500 feet in the general direction of the stream, and from base to base of hill. The wording seems simple enough, and in some places there is no difficulty in coming to an agreement as to where the base of the hill would be, but in other cases it is not so simple; perhaps no two of us would agree on the


Creek
Rim Rock

No 2


Present Creek
Surface of Ground
Old Channel
Bed or Rim Rock

same point. The rise in places was so gradual that it would require a level to show that there was a rise, and in others there might be a flat, miles in extent. Under these regulations claims might extend to an indefinite distance at right angles to the general direction of the stream if no hill came in the way to limit them. In the regulations which were authorized by Parliament in January, 1898, this defect was remedied by limiting the claims to 1,000 feet from the centre of the stream where the distance to the base of the hill exceeded 1,000 feet. There had been some five thousand claims registered under the other regulations before this change became the law. In returning to this "base of hill" question, Dominion Land Surveyor Ogilvie, when surveying claims on Bonanza and Eldorado creeks in the winter of 1897 recognized the fact that there was something more required before a surveyor could put down his stakes and say, "Here is the boundary between the creek and hill claims." He set out stakes at right angles to his traverse line, but he did not pretend to place them so as to limit the width of the claims. This was evidenced by the fact that the stakes were often a considerable distance up the hill sides, and were only set for alignment across the valley. At the time I arrived in Dawson in the spring of 1897, there were a good many cases of dispute where men were locating claims on the hill sides, and trespassing on what the owners of creek claims adjoining, thought was their ground. It was a daily event to be waited upon by a deputation or by single miners seeking injunctions to stop others from prospecting on ground which they claimed. Mr. Ogilvie, who had discussed this question with some of the British Columbia miners, arrived at the conclusion that a certain rise of the bed rock should form the boundary, and announced his intention of recommending a change in the mining regulations, substituting this provision instead of the clause, "from base to base of hill." I foresaw trouble ahead if this change should be adopted, and immediately wrote to the Department, expressing my objections to the change, and recommending instead that the claims be made a definite size—square would probably be the best; and let the boundaries be governed by the stakes at the corners. Any one familiar with conditions in that country would tell you that if this had been done a fortune would have been saved to many a man, who has been ruined through litigation. In the regulations, which were adopted by order-in-council, January 18, 1898, Section 10 reads as follows:

"A creek or gulch claim shall be 250 feet long, measured in the general direction of the creek or gulch. The boundaries of the claim which run in the general direction of the creek or gulch shall be lines along bed or rim rock, three feet higher than the rim or edge of the creek, or the lowest general level of the gulch within the claim, so drawn or marked as to be at every point three feet above the rim or edge of the creek, or the lowest general level of the gulch, opposite to it at right angles to the general direction of the claim for its length, but such boundaries shall not in any case exceed 1,000 feet on each side of the centre of the stream or gulch. (See Diagram No. 1.)

On turning to that diagram we find the rim rock coming out at the edge of the water, while the surface of the ground is not shown at all. There are cases where an outcrop of rock is found at the creek as shown in the diagram, but in nine cases out of ten the rock is anywhere from fifteen to two hundred feet beneath the surface of the ground, and many feet beneath the present creek channel, and a true cross section would appear as shown in diagram No. 2. Taking the wording of the definition and Diagram No. 1 together, it is shown to be ambiguous. When the writer received notice of this change in the mining regulations, and not wishing to act altogether on his own ideas as to the meaning of the term, "rim of the creek," he called on Col. Bowie an eminent authority on placer mining, at that time a resident of Dawson, and submitted the problem to him. Col. Bowie's definition of, "The rim of the creek," was the boundary of the creek channel, either above or beneath the surface of the earth, where the bed or rim rock had been broken or worn away." A similar explanation was given by Mr. Alfred Tregidgo, another mining engineer, to whom I submitted the same problem. These definitions coincided with my own ideas as to the intention of the clause as shown by the diagram. I, therefore, accepted that as the true meaning, and instructed the mining inspectors and all other inquirers accordingly; and that became the accepted interpretation until the fall of 1898, when, upon Commissioner Ogilvie's arrival at Dawson, he informed us that this was not the meaning of the Act; that the boundary intended was where a horizontal plane produced from the creek would intersect the bed rock three feet higher than the rim of the present creek channel. The boundary, which would be determined according to the two definitions, is illustrated in my Fig. 2.

One objection I raised to the first definition was that three feet of a rise was not sufficient to make allowance for ordinary undulations and natural irregularities of the bed rock, as these vary on the bed rock about the same as the surface of the ground. It was my explaining this to Commissioner Ogilvie which brought to his attention this ambiguity in that portion of the mining regulations, and he proposed having the defect remedied by having the diagrams changed so as to show the horizontal plane extended from points three feet above the edge of the present channel of the creek.

If this provision for overcoming the difficulty were applicable there would still be the undetermined problem, viz., the finding of the exact rim or edge of the creek. The edge of the water is seldom, if ever, at the same exact altitude for two days in succession. The limit of vegetation differs at every point along the creek, and is not the same on both sides of the creek. The surface through which the stream has cut its channel is undulating, so that the "rim of the creek" under the latter definition is quite as indefinite a term as the "base of the hill," as it appeared in the section which this clause was intended to amend. In conversation with miners, who spoke of the rising of bed rock as the true base of the hill, I found that they did not generally understand that the bed rock must rise to a point above the present channel of the creek, but that it must rise to a plane higher than the bed rock underneath the flat. Had the law allowed say seven feet or sufficient to overcome the natural undulations of an elevation above the rocky rim of the creek, there would have been little objection on the part of the miner. There still remains the indeterminate nature of the problem, viz., the impossibility of any engineer, however well qualified he may be, determining the elevation of the bed rock from the surface of the ground, when bed rock is anywhere from fifteen feet to two hundred feet beneath the surface of the ground, and of marking the boundary on the surface.

While in the Yukon territory I recommended some amendments to be substituted for these unworkable clauses, to overcome as far as possible the mischief worked by them, but my recommendations were not wanted, i.e., they were not approved by Commissioner Ogilvie, and as I did not return to the Yukon to survey the boundaries of mining claims, I left the matter for those on the ground to fight out as best they could. A prominent British capitalist who returned from Dawson without pur-

chasing claims for parties who employed him said, that to purchase a claim was purchasing a lawsuit, and he certainly was not far astray.

Another source of litigation arose through substituting the Regulations approved by Order-in-Council on the 21st March, 1898, for those bearing date of 9th November, 1889, referred to in Section 40 of the Regulations governing placer mining. Sec. 14 of the last named read as follows: "When there are two or more applicants for any mining location, no one of whom is the original discoverer or his assignee, the Minister of the Interior, if he sees fit to dispose of the location, shall invite their competitive tender, or shall put it up for public tender or auction as he may deem expedient. To show how useful that Section might become I will refer to the conditions which prevailed in the month of September, 1898, at which time claims which had not been worked in accordance with the mining regulations, were thrown open for re-location. During that month, upwards of one thousand applications were received together with the entrance fees, and placed on file. For the majority of the claims there were several applicants, and the leases couldn't be granted until these several applicants appeared together with their witnesses before the Gold Commissioner and obtained a hearing, which sometimes extended over two or three days. Had the section which I have quoted, from the former regulations been still in force, how quickly and easily all these cases could have been adjusted. The applicants offering the largest amount would have got the claim, while the other applicants would have had their money returned to them, and could have gone and sought a claim elsewhere. Up to last fall those cases had not all been disposed of, but to prevent trouble in that direction in future, the regulations were so amended that now all unrepresented claims revert to the crown and are not now available for settlement as mineral lands. In the case of fractions, the revoked section would have been most useful. All fractions, since the summer of 1898, have been held as alternate claims for the crown.

It would be in the interest of both the miner and the crown, that some provision be made for disposing of these fractions with as little delay as possible, after it had been ascertained that they have a real existence. I may here state that in the early history of the camps, many certificates were granted for fractional claims, which after the measurement of the original claims,

were found to have no real existence. Those who had been granted certificates either made a mistaken affidavit through their inability to measure accurately, or purposely perjured themselves for the purpose of obtaining a certificate to sell, and cheat someone out of their money. In granting certificates for these fractional claims we usually required not only the affidavit of the applicant himself, but also of the man who assisted the applicant to measure the claim. These certificates, supposed to represent claims, were many of them sold, and some of them for large amounts, and in some cases the purchasers found they had been swindled. Early in the spring of 1898, I refused to grant any more certificates for fractions unless the application was accompanied by a surveyor's certificate, and a sketch showing the measurements of the claim, and I recommended at the same time that fractions be held for the crown, that a double benefit might result therefrom.

First—Purchasers would be protected against purchasing fractional claims which might be found to be non-existent. Second—The fractions which did exist, if sold, would pay the cost of the survey, which in that country would otherwise demand a large appropriation—the expense being at least three times as great as it would be to survey and lay out claims on vacant ground, owing to the length of time which would necessarily be consumed in searching for original stakes, taking evidence, examining records, etc. The additional cost of surveying claims already recorded, in many cases, overlapping each other and irregular in shape, is the problem which the surveyor has to face. I will here note my reasons for urging that provision should be made for the early disposal of fractional claims. In many places where fractions are found the original claims of which they formed a part are being worked as well as the claims adjoining them, and as operations are carried on far beneath the surface of the ground, it is the easiest thing imaginable for those fractions to be undermined, in fact it would be a matter for surprise if they were not worked out by adjoining claimants. As to question of value, the fractions would be worth more to owners of adjoining claims than to any one else, because when working out the claim, the fraction could be worked out without the extra cost of opening up the ground, together with the expense for dams, sluice boxes, transport, etc., all of which would be unnecessary if the fraction were worked out in conjunction with one of the adjoining claims. As the

creek claims between Upper and Lower Discovery on Dominion Creek are being worked this winter extensively, and a list of the fractional claims had been made out and advertised for sale by the Department—I am sure the purchasers of these fractions will be somewhat interested in this part of my paper—of those fractions particularly which have not been acquired by the owners of adjoining claims.

When the regulation reserving alternate blocks of ten claims to the crown reached Dawson, I saw the necessity of adopting a rule for the guidance of those seeking claims, that they might know where to stake. The instructions given to prospectors, miners, mining recorders and others were, that the discovery claim whether a single or double claim should count as one and be numbered (0). That this claim and nine claims above discovery would be open for staking by the people, while the first block of ten claims below would be reserved for the crown. This gave uniformity in numbering, the same numbers belonging to government blocks, whether they begin at the mouth of a stream or some distance up, while measuring up stream. These instructions were made public through posting up notices, and publishing in the local papers, also in a small directory published as a private enterprise, which contained also, all the local rulings regarding representation and other matters pertaining to mining. There was a great deal to be said in reference to the law as it applied to the representation of claims, but as that part has been changed entirely, and provision made whereby a man may pay a sum of money at the recorder's office in lieu of representation, and the claims not being open for re-location by the public, I need not say any more on this subject except that if the amendment had been made a year and a half earlier, that feeling of distrust in reference to title which has hindered investment of capital to a considerable extent, would have been prevented. Where the land will never be valuable for anything except the mineral which it contains, and will be valueless and deserted as soon as the metal has been extracted, it would, I think, be for the benefit of the country, and aid in its development, if the same sort of title could be granted to placer ground as that granted for mineral lands containing rock in places. Such a title for valuable property would command a good figure. The limitation contained in Section 22, which reads: "A claim shall be recorded with the mining recorder in whose district it is situated within ten days after the location thereof, if it is

located within ten miles of the mining recorder's office," is not an improvement on the former Regulations, which allowed sixty days after staking for the purpose of prospecting a claim to ascertain if it would be worth recording. If the word "pre-empted" were substituted for the word "recorded" in the first line of the section, it would give general satisfaction. I am not acquainted with any creek in the vicinity of Dawson where two men could sink a shaft to bed rock in ten days. The average length of time for sinking a shaft to bed rock would be a month, and it often becomes necessary to sink three or four shafts before it can be ascertained whether the claim will be worth recording. Any man who values his rights and intends to mine, don't want to throw it away on a valueless piece of ground, and it is scarcely treating him with ordinary fairness to compel him to do so. The man who simply locates a claim, and procures a certificate for the purpose of selling, does not care to prospect, he merely sells for as high a figure as he can get. If a man were required to have his claim noted at the office for preemption for the purpose of protecting his right until he could do the necessary prospecting, he would not be required to sacrifice his right without knowing whether his claim contained mineral or was worthless. The entrance fee might be collected when the application for pre-emption was made, or otherwise, a regular fee for recording pre-emptions might be charged, as well as a fee for recording abandonment of these if the claim was not deemed worth holding. Miners with whom I discoursed on the above subject have said, they would much rather pay the fifteen dollars' fee, for the privilege of prospecting, and lose it, than record a claim which turned out to be worthless. There are many other points in connection with the mining regulations which might be discussed with profit, but my paper is already quite lengthy enough, and I trust will have some interest for the members of this Association.

DISCUSSION.

The President—We begin to understand some of the difficulties of the officials in that distant country after listening to this paper. It will be a valuable contribution to our annual report. No doubt many of you will remember that a year ago, when Mr. Ogilvie contributed a paper on the Yukon, at that time

very little was known about the country, and there was very little attention paid to it. But it has been a source of great satisfaction to us to know that our Proceedings contained the first account of that wonderful land of gold.

Mr. E. Bolton—I accompanied Mr. Fawcett in the summer of 1897, and I can say that he is perfectly correct in everything he says; the conditions of the country were so different from any other place. He has put some of the facts in very good shape, and very plainly.

Mr. Sankey—In listening to the paper it occurred to me that unless one was very well versed it was rather hard to follow. In the first place, I am ignorant as to whether the claims are first to be certified by the surveyor; and I assume that this is possible from the occurrence of the fractional sections or portions. Perhaps Mr. Fawcett will be kind enough to give an explanation, that we may know not only for ourselves, but that it may also be put into the Report, for many people who read our Reports do not belong to Ontario at all.

Mr. Fawcett—The claims of that country are all staked and recorded long before any surveyor is on the ground.

Mr. Sankey—Did the fractions occur from the survey made?

Mr. Fawcett—Yes. In the first place when Mr. Ogilvie went up to survey, the people were disputing over their ground. He measured the claims, and after measuring off the claims all exceeding 500 feet was cut off, and that was a fraction. He cut off the fraction, and just allowed 500 feet.

Mr. Sankey—What happened in the case of the work being done on the fractional part?

Mr. Fawcett—That is where the people have no certainty, they have no way of knowing that their fraction has not already been worked out.

Mr. Aylesworth—I move that Mr. Fawcett's paper be received and printed in the Proceedings, and that the thanks of the Association be tendered to Mr. Fawcett.

Mr. Ross—I second that.

Mr. Bolton, Sr.—I think, as far as I am concerned, I know what difficulties there are, but I would not wish to place all the knotty questions before this Association. The only way that you can appreciate that kind of thing is to go there. I know all I want to know about that, and I do not think it would be

very instructive to the members of the Association unless they had something to do in the survey of the country. In what Mr. Fawcett has said he has explained the whole matter thoroughly, and I think that any comments on my part would be useless. I am satisfied that the present mining regulations are not just exactly what they should be. I think that what Mr. Fawcett says about them is practically right. The difficulties set forth in Mr. Fawcett's paper are very striking. It is a very hard matter to say what the mining regulations of that country are. There are just as many different kinds of humanity in that country as you will find anywhere, and it is a pretty hard matter to make laws that will govern every case. During the two summers I was there I found a great many difficulties in satisfying the laws in making surveys. The laws in a good many places, so far as the creek claims are concerned, are very indefinite, and especially that one in reference to the boundary between the creek claim and the hillside claim. That is a matter that I think every surveyor in that country feels a difficulty in determining, and it is for this reason that there has been a great deal of money spent in litigation. I do not think it is necessary for me to say anything more on the subject at present unless some member would like to ask questions. Motion carried.

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THE YUKON COUNTRY.

E. D. BOLTON.

On May 6, 1899, I left Toronto via the C. P. R. for the Yukon to act as assistant to Mr. Thos. Fawcett, D.L.S., gold commissioner for the district, arriving at Vancouver on the 10th day of May. The following day I took the boat to Victoria, where I found Mr. Fawcett and party busily engaged completing our outfit for the journey. On May 15th we sailed on the steamer "City of Topeka" for Juneau, arriving there on May 18th. Juneau has a population of about 2,500, and is situated on an Island at the mouth of the Lynn canal. While there we visited Douglas Island, on which is situated the Treadwell Mine, having the biggest stamp mill on the American continent, some of the ore used not running $2 to the ton. We then started up the Lynn canal on a small steamer, and reached Dyea on May 21st. Dyea is situated on the left arm of the Lynn canal, the distance from Juneau being about 100 miles. On our way to Dyea we stopped on the right arm of the canal to wait for the tide, this place being only a few miles from Dyea, where now is situated the town of Skagway, with a population of over 4,000 people. When we landed in 1897 the place was nothing but a wilderness. There was one hut, in which lived Captain Moore, a pioneer, who then laid claim to a portion of the land. After landing at Dyea on May 24th, we commenced packing our outfit, which consisted of kit-bags, provisions and surveying instruments. We tracked part of our outfit in boats and canoes five miles up the Dyea River, the remainder being taken in a waggon. From here we packed our outfit, including two canoes, to the summit of the coast range, over the Chilkoot pass, and in doing so had considerable difficulty.

There is a good sized glacier on the left of the trail, about two miles below the summit, and while there we could see large pieces of ice breaking off of it, which sounded like thunder as they rolled down the mountain side. Once landed at the summit

we procured sleighs, and sledded our outfit down the pass, a distance of about six miles, to within about two miles of Lake Linderman. Across this two miles we packed our outfit, and landed it at the head of the lake on June 7th. We then transported across the lake in boats and canoes, it being about four miles. We then packed three-quarters of a mile across the portage to the road to lake Bennet. While at Linderman Mr. Fawcett, in company with one man left for Dawson, arriving there about June 16th.

At Bennett and Linderman, and scattered along the portage between the lakes, there were about 1,000 people, building boats and getting ready to go down the river, their tents scattered all over the place. About a mile from Bennett there was a sawmill, where we procured a boat twenty-three feet long, made of three-eighth inch spruce, spruce being the only available timber there, and found up to about fourteen inches in diameter. The small price paid for the boat was $75. We then loaded our outfit in it and a Peterborough canoe, and on June 12th started for the gold fields. The trip down the river is delightful as soon as you get across the lakes and into the river. The paddling of a canoe is not so hard, as the strong current carries one right along, the current in some places being five miles an hour. We arrived at Fort Selkirk on June 22nd, and there found instructions to complete some surveys which had been commenced by Mr. William Ogilvie, D.L.S., Mr. James Gibbon, D.L.S., being in charge of the survey. We laid out at this point over 1,000 acres, including forty acres for a Government reserve. Fort Selkirk is the best situation for a town site of any place on the river, and is 180 miles above Dawson. There are a number of Indians here, and also a trading store, owned at that time by Messrs. Harper and Ladue, an Englishman, Wm. Pitt by name, being in charge, who did all the trading with the Indians. The stock-in-trade then consisted of eight sacks of flour, a few odds and ends in groceries, a few articles of dry goods, 100 fox skins, mocassins and mittens, 400 bearskins, and about 800 tanned cariboo and moose skins, the moose and cariboo being shipped to Dawson in the fall for the making of mocassins, and brought from ten to twenty dollars apiece. At Selkirk on the 1st of July I picked ripe strawberries in a hay meadow about three miles back of the fort. I almost forgot to mention that coming down the river we did not run any of the rapids with our canoe. Our big boat went safely through the Canyon and Five Fingers, and we portaged over the White Horse rapids, Canyon and White Horse being only two

and a half miles apart, the water between them being very rapid and dangerous. On Monday, July 5th, we left Selkirk for Stewart River, a distance of 110 miles, arriving there the following afternoon. We travelled the distance of ten miles between White River and Stewart in fifty minutes. At Stewart River we made several surveys, including a Government reserve of forty acres. The land applied for, both at Fort Selkirk and Stewart River, was not granted to the applicants. The valley of the Yukon in the months of June and July is lined with wild flowers of various kinds; wild roses grow in abundance. The most of the flowers of that country are of a violet or purple hue. The islands in the Yukon are thickly wooded in places, the timber being chiefly of spruce, with some small white birch and poplar. While surveying at Stewart River we came across some spruce trees that would measure two feet in diameter.

The varieties of wild fruit found along the valley of the river are cranberries, strawberries, blue berries, raspberries and red and black currants. On July 17th we left Stewart River for Dawson, and canoed the distance seventy miles in ten hours, arriving there in the evening. The population of Dawson when we arrived would be about two thousand. We camped on the police reserve, and lived in tents the remainder of the summer; in the fall we moved into a snug little cabin built by our party. The Gold Commissioner's office, which was situated near the lower end of the town, seemed to be the principal place of attendance. Some mornings when we went down to the office we would find a line of men from two to six deep, reaching from the office to the bank of the river, and numbering over two hundred, eager to get in and record their claims. With regard to the first discovery of gold in the Klondyke, I may say that the gold diggings before this were situated down on the tributaries of Forty-mile River, near the boundary line, and about fifty miles below Dawson, the principal creeks being Miller and Glacier, the pay dirt running from five to ten cents to the pan. In the first months of 1896 a few miners found their way up the river to the Irvandik, where gold was found on Bonanza, Eldorado, Hunker, Gold Bottom and Last Chance Creek, although some time before this gold was discovered on Quartz Creek, a tributary of Indian River. Shortly after this the richness of these creeks was soon known, Eldorado being the richest, then Bonanza and Hunker. Some of the best claims on Eldorado selling for $100 now are worth $200,000. As soon as Mr. Fawcett arrived in 1897 he divided the country into

mining divisions. Every creek or river flowing into the Yukon together with its tributaries, comprised a division, and each miner was entitled to record a claim in each division. The creek claims at this time were 500 feet in length, the discovery claim being 1,000 feet in length. The bench claims were 100 feet square, the same as in British Columbia. Up until July, 1897, there were less than half a dozen bench claims located, being on Eldorado and Bonanza Creeks. In September, 1897, bench claims took a jump, and many were located on these two creeks, and now bench and hillside claims are to be found on all the principal creeks in the district; in some places on Hunker Creek they extend back from the creek a distance of over half a mile. Some of the richest claims in the country are bench and hillsides. On French Hill, situated on the left limit of Eldorado Creek, between claims Nos. 17 and 13, is a large group of 100-foot bench claims. On May 1, 1898, I visited some of these claims, and several of them were, with one rocker, producing about $1,000 a day, the gold being coarse and in nuggets, some weighing over two ounces. In 1898, when the new regulations came into force, the size of creek claims were cut down to 200 feet in length, although a 100-foot law before this was never put into force. Every alternate ten claims are reserved for the Crown; discovery claims being 400 feet in length, and nine additional claims above this are put on record, and then the ten claims above and ten below this are reserved for the Crown. All the creeks in the county where claims have been recorded in this manner have remained unprospected and undeveloped, for the reason that the individual miner is not going to develop ground for the benefit of the Government. The size of hillside claims are in length 250 feet, up and down stream, and extending at right angles to a base line of the creek 1,000 feet. Bench claims are 250 feet square, and are mostly located back of the hillside claims.

With regard to quartz claims, I may say that they are located all over for a radius of fifty miles around Dawson, but as yet they have been found to be worthless. There are no well-defined quartz ledges in the country, and no rock of any kind found in the place. My opinion is that the country at one time has been over-run with quartz ledges, and that these through time have worn down, and the placer diggings of this region are the result of these worn-down ledges. Most of the gold nuggets found are mixed with quartz, and I have often seen in a gold pan when the dust was being cleaned up over a cupful of fine particles of

quartz. Black sand is found along with the gold dust, some creeks being worse than others for it. On Dominion Creek, a tributary of Indian River, it is found in very large quantities. The principal creeks on which good pay dirt is found are the following: Eldorado, Bonanza, Hunker, Dominion, Sulphur, Gold Run and Quartz Creek.

Concerning hydraulic mining, I may say that up to the first of October last there were only about half a dozen leases granted for hydraulic mining concessions in the Yukon territory, the first being for two and a half miles of ground near the mouth of Hunker Creek; the second being for ground on the left limit of Bonanza Creek. There were, last September, in all, over fifty applications in for hydraulic mining for ground on the Yukon River, Irvandik River, Bonanza Creek, Eldorado Creek, Hunker Creek, Indian River, Dominion Creek, Quartz Creek, Stewart River and its tributaries, Forty-mile River and tributaries and others. There is plenty of good ground suitable for this method of mining that would yield from two to ten cents to the pan, but the scarcity of water prevents this ground from being worked. There are two large schemes on foot now. One is to bring water down in a flume or ditch from the head waters of the Irvandik. The other is to pump water out of the Yukon and over the divide to the head of Eldorado Creek; but I don't think either of these will be carried out, as the cost would be greater than the benefits derived therefrom. Coal is found along the Yukon in a number of places, one near Five Finger Rapids, and several below Dawson. On Cole Creek, sixty miles below Dawson, last summer the North American Trading and Transportation Company did considerable development work on their property. They shipped to Dawson over 1,000 tons, to be sold at $25 a ton. This coal seemed to be very clean, and was reported as being of good quality. The Alaska Commercial Company also have coal locations down the river, but the coal does not seem to be of uniform quality, and the vein is too thin to be worked to advantage. According to recent information, derived from Dawson through the "Toronto Globe," the Alaska Exploration Company for the past six months have been tunnelling for coal on Rock Creek, a tributary of the Irvandik River, entering from the right bank, about fifteen miles above its mouth. They have finally opened what they hope will prove a permanent seam or series of seams, they have tunnelled 800 feet, 400 feet of which are side galleries, and two of these run through coarse seams seven or eight feet

thick. The men are working at a depth of 250 feet and at present there is about 1,000 tons of coal exposed to view. The coal is bituminous in character. This is the nearest coal-find in the vicinity of Dawson, and is seven miles up the creek, from its mouth. Should the mine prove permanent it is the intention of the Company to build a tramroad from the property to Dawson, which would land the product of the mine right in the town.

I will now give you a short account of the business done in Dawson, in 1897 and up until the fall of 1898, the most of the trade was done by the North American Trading and Transportation Co., and the Alaska Commercial Co. These companies steadily increased their business as the increase in the population demanded it. The Alaska Commercial Co. have now seven river boats costing at least over $400,000, also a large store and four large warehouses.

The North American Trading and Transportation Co. have about the same number of boats, but not as elaborate as those of the former company. They also have a large store and five warehouses, besides a number of very valuable mining claims. These two companies transacted business without opposition until the fall of 1898, when the Alaska Exploration Co. brought in a large stock of goods, and commenced building warehouses and stores. This company have now three large warehouses, four river boats, and the finest store in Dawson, and have in some particulars outshone the other companies: counters, shelves and store fixings all made of imported woods, and in every particular up to date. Besides these there are other smaller companies now doing business. When we arrived in Dawson in 1897 supplies of all kinds were very scarce as the up-river boats had not yet arrived from St. Michael's. The miners had plenty of money but nothing to buy except a little bad whiskey. The river boats only make two to three trips in a summer, the mouth of the river not being open until about the middle of June. It takes a boat from twenty to thirty days to make the trip of 1,700 miles from St. Michael's to Dawson, and about seven days to make the trip back again; this, of course, not counting the time spent being stranded on sand bars, as the river in some places is very bad. There is one place in the river called the Yukon Flats, about 400 miles below Dawson, where it widens out to a width of about ten miles. Here the river is very shallow, and the channel changing and shifting all the time. River men have told me that they are

very seldom able to pass through this part of the river twice in the same place.

There are now about fifty river steamers plying up and down the Yukon, ranging in draught from one foot up to four and a half feet.

I will now attempt to give a short account of some prices paid for different articles in Dawson. Of course, the prices change as the stock in trade increases or diminishes. In the summer of 1897 flour sold for $8 per fifty pound sack; sugar, 50c. per pound; bacon, 50c.; fresh meat, 75c. to $1; canned meats, 50c. to $1 per can; butter, $1; candles, $5 per box of fifty; boots, $8 to $10 per pair; top shirts, $3 to $4; good suit of ready-made clothing, $50; coal oil, 50c. per gallon; dried fruit, 50 to 75c. per pound. Later in the fall and winter, as nearly everything became scarce, flour sold for $50 per sack; bacon, $1; candles, $10 to $20 a box; coal oil, $5 per gallon; butter, $3 to $5 per pound; moccasins, $10 per pair; wood, $35 a cord, and hay, $400 a ton, the hay being cut along the valley of the Stewart and Yukon and brought down the river on rafts. Horses sold from $300 to $500 apiece; ordinary lumber suitable for building from $75 to $100 per 1,000 feet, and sluice timber, where ten and twelve-inch boards are used, generally brought a higher price. Rents were very high until the summer of 1899, when a good cabin, about 14 by 16 feet, in the central part of the town, could be rented for $25 a month. Before this I have seen the same sized cabins bring $75 a month. On Main Street last summer along the river front in the business part of the town ground rent was $10 a foot per month. Sled dogs ranged from $50 to $100 a piece, although once I saw four large huskies sold for $1,000, but these very fine animals. The first fresh eggs brought into Dawson in the spring of 1898 sold for $18 per dozen. These prices will perhaps never be realized again in that country, as everything is now working down to a level, and keen competition exists in every line of business. Prices last fall were the following: Flour, $6 per sack; bacon, 25c.; ham, 35c.; canned meats, 50c.; sugar, 30c.; beans, 25c.; butter, 75c. to $1; dried fruit, 25c to 50c.; eggs, $2 per dozen.

With regard to the climatic conditions in the country, I may say that, although the winters are very cold and the summers are hot, one does not feel it as much as would be expected in that north country. There is very little wind, and the weather is steady, and not like it is in this part of the country, summer to-day, followed by winter to-morrow. The average of rain and

snowfall is not nearly as much as here. The total snowfall in the winter of 1897-98 was a little over three feet, and in the winter of 1898-99 a little over two feet. The heaviest rain falls exist in the months of June and July, when the river is then at its highest, the fall after that being very light. The lowest temperature we had in the winter of 1897-98 was on the last day of November and the first day of December, when Nigretti & Zamba's minimum thermometer registered 55 degs. below zero. The lowest temperature in the winter of 1898-99, according to the same thermometer, was 47.5 degs. below zero, the former winter being more severe than the latter. The Yukon remains frozen over from six to seven months in the year, and navigation can safely be conducted from about the middle of May until the first of October. In September the river gets low, and the boats are continually coming into contact with shoals and sandbars, and navigation becomes difficult. The ice coming in from the tributaries generally runs ten days or two weeks before the river becomes entirely frozen over. The water in the Yukon in the summer is of a muddy color, but as soon as it becomes frozen over, the water becomes clear. I have seen the ice in the river attain a depth of over seven feet, and in some places, in the eddies near the shore, I have no doubt it would be ten feet.

My term of office with the Government expired on May 1, 1899, and since that time I have been in business for myself. I will now give a short account of my trip out last fall. On September 26th we left Dawson on the steamer "Victorian" with over 100 passengers on board, and anchored that night at Monte Cristo Island, twenty miles nearer home. About six miles up we passed the Government telegraph line, it then being completed to this point. On the night of September 28th we tied up at Selwyn River, and here found that the telegraph line had been completed to Dawson. This was quite an advantage, as we could at the different stations find out the whereabouts of the other steamers, and also find out what steamers had arrived at Skagway. On October 3rd we reached the mouth of the Hookelinqua River, sometimes called Tes-lin-to, or Newberry River. Here I took the temperature of the water, and found it to be 44 degs. Fahrenheit, which led us to believe that it would be some time before there would be much ice in the river. We arrived at Bennett City on October 5th, and took the noon train for Skagway, arriving there at six o'clock in the evening. The Yukon and White Pass Railway runs between Bennett City and

Skagway over what is known as the White Pass, the distance being about forty miles. This is a narrow-gauge road, and in places has some very steep grades. The road was completed last July. In the fall the company were getting out timber and preparing to build snow-sheds. The single fare on this road from Bennett to Skagway is $10. At Skagway one can buy goods just about as cheaply as at Seattle or Vancouver. You can get a good, square meal for 25 cents. This place has electric light and water works, the water being brought down out of a small lake in the mountains near by, over 1,000 feet high. October 7th we left Skagway on the steamer "Humboldt" for Seattle, arriving there on the morning of the 11th. The trip down was very pleasant, and reminded one of the Thousand Islands. On our way we passed three glaciers. The channel used by the boats coming down the coast is that laid out by the United States Coast and Geodetic Survey, and complete charts are made of the same. On October 17th I left Vancouver, via C.P.R., for Toronto, arriving here on October 22nd, and was glad to get to my journey's end.

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LOW GRADE ORES.

By H. DE Q. SEWELL, A. M. Inst. C.E.

The subject for this paper suggested itself to the author from reading the following extracts from p. 143 of the Seventh Annual Report of the Bureau of Mines, by Dr. A. P. Coleman, on the subject of the West Ontario gold region, where, after remarking that "the number of mines actually producing gold has largely increased," he states: "It must be admitted, however, that several of these mines are producing ore of lower grade than was anticipated," and further on he emphasizes this statement by saying: "On the whole, the conviction is being reached that, in spite of a few fairly rich veins, our gold ores are in general of *low grade*, though often present in amounts extensive enough to justify working on a very large scale. Fortunately all the properties developed except those of Marmora prove to have essentially free milling ores, so that the cost of treatment is reduced to a minimum. As roads and steamboat and railway connections improve the cost of labor and supplies will fall; and ease of access, with a salubrious climate and safety for life and property *must give the region an advantage over most others.*" This statement is fully borne out by the author's own observations during the past eighteen years in Western Ontario, and hence the necessity, when searching for properties likely to develop into paying mines, the general trend in Western Ontario should be to give a preference to low grade veins containing sufficiently large bodies of ore to permit of extensive, and consequently cheaper mining operations from what could be carried out on narrow veins of higher grade ore. Marmora being situated east of Toronto, Dr. Coleman's remarks as to the free milling qualities thus fully applies to the general run of veins in the western section of Ontario. The author's experience of these ores is that about one-third, or 33 per cent., of the gold contained in them is free milling, and that about 77 per cent. of the gold in the tailings can be extracted by the cyanide process; the total saving

being equivalent to 84 per cent. of the gold contained in the ore. Thus the subject of *Low Grade Ores*, with its subsequent corollary, *when it will pay to work them*, is an important topic, and one which constantly presents itself to the mining engineer, and through him to the investing public.

The principal requirements for mining low grade ores successfully are: (1) Free milling or partially free milling ore, the residue being capable of extraction either by chlorination or the cyanide process. (2) A large body of ore. (3) Facilities for cheap mining, water powers, etc. (4) Easy and cheap means of communication. (5) Thoroughly testing the vein before developing it into a mine. (6) The erection of a large milling plant and other mining machinery. In this way only can the cost of production be kept down to the lowest possible point per ton that will permit the mine to be operated successfully, and if properly conducted will usually yield greater profits than are likely to be obtained from a narrow vein of high grade ore where a lot of dead or unprofitable rock has to be mined to afford room to take out the ore. This prudence will generally give the preference to a wide vein of low grade ore as more likely to yield permanent and uniform results.

There are also a number of questions of almost equal importance that require to be carefully looked into, such as whether the ore is hard or soft; whether the rock is easily supported or requiring close and immediate filling; the manner of recovering the ore bodies, whether by means of tunnels or through shafts; the quantity of water; cost of timber; cost of labor and supplies; distance from mine to mill; kind of motive power and its cost. These points have all to be carefully considered, and have a direct bearing on the cost of mining.

The reduction of the ore is another and distinct branch of vital importance, and presents a number of conditions that require careful consideration. The hardness or softness of the ore has a direct effect on the crushing capacity of the mill, but large capacity per stamp is not always productive of the best results.

The fineness of the gold or its association with other minerals determines in a large measure the capacity of the mill, and also the extent of subsequent treatment.

To obtain the best results at the lowest cost is the object throughout, and to accomplish this requires a careful consideration of the equipment and methods of mining to be pursued. The ore, having been brought to the surface with as little hand-

ling as possible, should go direct to the mill, thus when dumped on the grizzles it should pass automatically downwards by gravity from one operation to another until the pulp passes to waste, after having been relieved of all the precious metal that can be economically extracted from it. In short, success can be obtained in the treatment of *low grade ores* only by the most careful and economical operations, conducted on a large scale, so as to reduce the cost to a minimum. A mine must be made, and it usually requires a large expenditure of time, money and planning to ensure the desired result; but no amount of money or scheming can make a mine where the values do not exist in the ground. Some mines require much less money and time than others to achieve greatness, and in some instances the promoters of mining schemes attempt to *thrust greatness* upon the mines they are endeavoring to sell.

The question of what constitutes the difference between high and low grade is often assumed to be about $20 for high grade, and about $5 or $6 for low grade ores. A comparison of the average values from the principal free milling gold-producing camps shows a total average of $6.53 per ton, from which it is evident that $5 per ton may be considered low grade, and $7 per ton as an approach to high grade ores. New Zealand, which gives the highest average on the list, is one of the smallest producers, whereas the lower grade ores produce by far the largest portion of the world's supply. Comparing these with our West Ontario mines we find:

	Average value of ore per ton.
Mikado, Shoal Lake, Lake of the Woods	$7 00
Sultana, Lake of the Woods	6 00
Regina " " "	6 00
Golden Star, Lower Seine Valley	5 65
Hammond Reef, Upper Seine Valley	3 70
Alice A., Lower Seine Valley	5 60

These values are necessarily liberal, as it is difficult to arrive at exact values. They give an average value to West Ontario gold ores of $5.66 per ton.

The principal low grade ores are the Alaska Mines and the Homestake Mine, South Dakota, U.S.A. The following are the returns for the latter, which employs 540 stamps:

Averages per ton of ore.	
Return from mill, including concentrates	$4 31
Cost of mining, etc	2 73
Net earnings	$1 58

The Alaska Mines are still lower grade, but like the Homestake Mine, they have large ore bodies (practically quarries), which reduces the cost of mining to a minimum, and consequently the profits are enormous The Alaska Treadwell has 660 stamps, the Alaska United 220 stamps, and the Alaska Mexican 120 stamps. The following are their official returns:

Averages per ton of ore.	For year ending May '99. Alaska Treadwell.	For year ending Dec. '98. Alaska United.	For year ending Dec. '98. Alaska Mexican.
Return from mill	$1 76	$2 48	$1 58
From concentrates, mostly chlorinated.	95	1 48	73
Total returns	$2 71	$3 96	$2 31
Mining, milling, etc	1 28	1 29	1 67
Net earnings	$1 43	$2 67	$0 64

The average of these Alaska ores is $3, and they yield an average profit of $1.58 per ton after paying all expenses. These financial results are amply sufficient to prove the great values that have been obtained from them, and also to encourage others to emulate them.

It may be mentioned that in North Mexico the Snodgrass mill, just completed at San Pedro, proposes to mill gold ores that average $2 a ton. They claim to have a large body of this ore, on an acreage of 800 acres, which they have acquired, and from which they anticipate profitable results.

In West Ontario large bodies of low grade ore are not uncommon, but so far little has been done towards their development; in fact, with the exception of the Mikado most of the principal mines come under this category. So far the Hammond Reef and the Alice A. are the largest known bodies of low grade ore. The Hammond Reef is situated on Sawbill Lake, and is 500 feet wide. It has hitherto carried ore worth $3.70 in gold per ton. It costs twenty-five cents to mine and deliver at the mill (the excavation being practically a quarry), and $1.87 per ton to mill, making a total cost of $2.12 per ton, thus leaving a net profit of $1.58 per ton. They have, however, recently put up a forty-stamp mill, worked by electricity, generated by water power, which they estimate will reduce the cost of mining and milling to $1 per ton. If this is accomplished it will raise the net profit to $2.70 per ton, which should enable them to pay handsome dividends. Recent reports from the mine, however, claim that at

the depth of forty feet in the quarry that they have reached ore values at $13 per ton. The Alice A. (situated on the Lower Seine valley) claims also to have a vein or reef 500 feet wide, yielding an average of $5.60 of gold per ton. Should they, when operating on a large scale get half these values it should prove to be exceedingly valuable, and would be the means of directing more attention to similar large deposits. The general trend so far has been to develop only the richest veins; these are mostly narrow, and when the ore falls in values or the vein reduces in width, it becomes a burning question as to whether the ore will, after paying the mining and milling expenses, leave any profits for the shareholders. Such a state of affairs, however, is not so likely to occur in a large deposit of low grade ore, for the vein or reef in such cases is usually strong and persistent, and can be cheaply quarried. Should there be a change of values with depth, it may, like the Hammond Reef, be in the direction of higher values, and whilst they last will be of considerable benefit to the fortunate shareholders.

The Alice A. and Hammond Reef are only illustrations of what can be done in Western Ontario. That many other large bodies of low grade ore exist in that district is indisputable, and the author believes that in the near future these and similar large bodies of low grade ore will prove to be the principal gold producers in Ontario. Even in the Transvaal (which before the present war produced 25 1-2 per cent. of the gross gold output of the world), in their principal deep level mines of high grade ores, where they have mills varying from 150 to 200 stamps, the actual amount of gold extracted and profits per ton is anything but high, as the following table, taken from the reports for 1898 of three of their best mines, will show:

Averages per ton of ore.	Crown Deep.	Geldenhuis Deep.	Rose Deep.
Return from mill	$5 52	$6 31	$6 31
Return from cyanide plant	4 54	3 34	4 20
Total returns	$10 06	$9 65	$10 51
Mining, milling, etc.	6 42	4 88	5 48
Net earnings	$3 64	$4 77	$5 03

The average of these three mines being $10.07, extracted from the ore at an average cost of $5.59, leaving a net profit of $4.48 per ton. As before stated, the average values in the Transvaal is $7. These mines are considerably above the average, yet it is

evident that under existing conditions these mining operations could not well be profitably carried out on a small scale, although, were the conditions more favorable, much lower grade ores would probably be mined. Thus the experience of gold mining all over the world goes to show that the greatest production and largest profits are likely to result from mining large bodies of low grade free milling ores, capable (with the use of modern machinery) of being mined and milled at a minimum cost, thus reducing the risks which are inevitable in mining high grade ores, and ensuring greater security for the capital invested, that should always be the primary object in all mining enterprises.

The editor of the "North American Mining Journal," published in London, England (Mr. Lefroy), gives the following opinion as the result of a visit to the West Ontario gold fields last summer, which, as it fully endorses the author's opinions, may be here quoted, viz.: "As facilities increase, the average value of the ore mined will steadily decrease, while the tonnage will steadily increase, and with the increase of tonnage the aggregate profits will also increase, while the profits per ton will diminish. This decrease will probably be arrested at the point of 4 1-2 dwt. per ton, although in individual cases ore of a lower grade than this may be profitably mined. It may seem an extravagant statement to make at the present time, but it is made with a full sense of what it involves, that the Rainy River district of Ontario has ore enough of this character to make it one of the dominant factors in the gold production of the world, and probably the dominant factor in the gold production of North America." This statement is particularly encouraging, as it appears from recent developments in British Columbia, resulting in the shutting down of the LeRoi, War Eagle and Center Star, that high grade smelting ores cannot be depended on, as their margin of profit is exceedingly low, and consequently the future gold production of Canada will necessarily have to depend largely on the free milling ores of Ontario.

The following is a tabulated list of the gold productions of the world for 1898 and 1899, the latter being approximate:

	1898.		1899.	
	Fine oz.	Value.	Fine oz.	Value.
Africa	3,852,187	$79,624,691	3,648,889	$75,339,851
Australasia	3,013,763	62,294,481	3,777,559	78,082,171
United States	3,148,648	65,082,430	3,506,679	72,483,055
Russia	1,196,634	24,734,418	1,164,603	24,072,344
Canada	662,796	13,700,000	872,227	18,049,593
Mexico	398,487	8,236,720	448,783	9,277,351
India	375,704	7,765,807	411,106	8,498,571
China	321,293	6,641,190	321,293	6,641,190
Rest of the world	1,019,255	21,068,042	1,024,045	21,510,342
	13,988,767	$289,147,779	15,175,184	$313,954,468

The Sawbill Mine's charter of incorporation is dated 26th May, 1896, when the first mining stock of any moment in this country was floated, principally in Hamilton. Up to that date very little work had been done in gold mining in Canada, and what had been was chiefly of an exploratory nature and the gold production very trifling, but now within less than four years' time Canada has become the fifth largest gold producer in the world, which, to say the least of it, is exceedingly encouraging, and bids fair to hold a still more prominent position in the near future. This, however, can only be the result of steady developments, conducted on strictly business principles, chiefly from the careful exploitation of the low grade free milling ores of Ontario.

DISCUSSION.

The President—You have heard this very interesting paper by Mr. Sewell on the development of New Ontario as it is called. Now, I shall be glad to hear discussion from some of the members who are familiar with the subject.

Mr. Aylesworth—I have listened with interest to the paper. I think it will be a good historic record for us to refer to if it be printed in the Report. I would move that this paper be received and printed in the Proceedings.

Prof. Galbraith—I think we ought to be congratulated on having such a paper. Mr. Sewell has evidently gone to a great deal of trouble in working up these statistics, and I have no doubt that they are accurate; and I think that they should be put on record as I have no doubt that they will have a permanent value. I do not know exactly the cost of farming,

but it seems to me that possibly the profits to be made out of clay might almost compare fairly well with the profits to be made out of low grade ores; and there is no doubt a very much larger area, so to speak, available for farming than for gold-bearing. I have pleasure in seconding the motion. (Motion put and carried.)

Mr. Lewis—I have listened with a great deal of pleasure to Mr. Sewell's paper on low grade ores. I have had a great deal of experience in mining, and I quite agree with what he says: low grade ores should be mined properly. If they are in large bodies, and they generally have to be in large bodies on the surface to be mined profitably; but you cannot mine low grade ores profitably if you have to do deep mining, unless you have a tremendous ore body. Therefore, if you take a mining proposition in this country or any other country you would have to have a large ore body that you can acquire to make it profitable. That is my experience.

Now, the Alaskan mines have paid larger dividends than others where the ores have been richer, but the ore bodies have not been as large. There is a reference made to them by Mr. Lefroy in the "North American Mining Journal," published in London, Eng.: "I have no doubt, indeed, that they have large ore bodies in the Rainy River district that can be acquired without deep mining." That there is a lot of money in low grade ores is the experience anyway in the United States. In these Alaskan mines there is an immense body of ore; and they simply put in a lot of shafts and throw out tons at a time. When you get down a thousand feet water gets into the mine, which adds to the expense. If you have large ore bodies, and have them practically on the surface, they are better propositions than the richer ones.

The President—It would be much better for the engineers if there were deep mining. Where there is this deep mining and the putting in of shafts and that kind of thing, engineering skill of a high order is required. Some of our School of Science men are now in British Columbia, where that is necessary.

[This Association is not responsible as a body for the opinions expressed in its Papers by Authors.]

SYSTEM OF SURVEY.

By S. BRAY, O.L.S.
Ottawa.

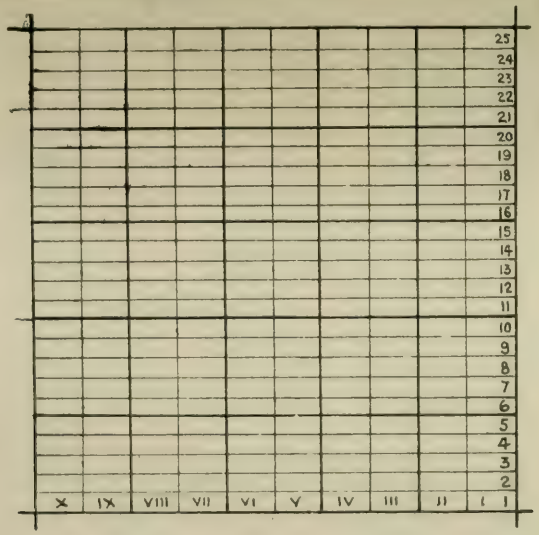
When it is proposed to survey a large tract of land into townships and lots, in order that the land may be conveniently sold, or otherwise granted to corporations or individuals for settlement, the most important point to be decided is the system of survey to be adopted.

The system adopted in the North-west Territories and in part of British Columbia is an admirable one in many respects. I have no doubt all present are familiar with it. Without going into details it may be described as follows: Principal meridians were drawn north from the 49th parallel of latitude at distances apart of about 4 degs. of longitude. Between these at equal distance of 24 miles, base lines were projected in chords of six miles, drawn west along parallels of latitude. From these base lines were drawn meridians at each interval of six miles the outlines of townships, to the depth of two townships to the north and two to the south. Each outline is, therefore, 12 miles long, and terminates in the centre of the space between the base lines. A line called the correction line is then drawn connecting the terminal points.

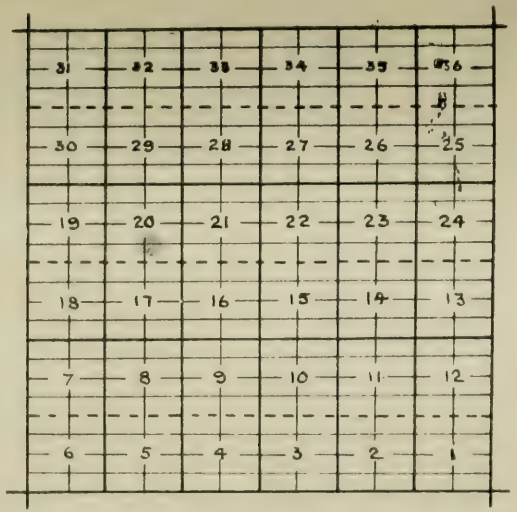
So far the outline system cannot be much improved on as to subdividing the land by meridians and base lines. The points I would draw attention to are in connection with the interior subdivision of the townships.

The townships are six miles square, and subdivided into thirty-six sections of one square mile, or 640 acres. The sections are numbered from one to thirty-six, commencing at the right hand lower corner of the township, and running zig-zag across it to the top. Each side of every section is also marked with a quarter section post planted in the centre. Lines drawn across the section connecting these posts divide the section into quarter sections of 160 acres.

An allowance for road was made around each section, one chain and a half in width, which was afterwards reduced to one



A Township 6¼ miles or 500 chains square divided into Concessions and Blocks of 1000 acres, and into Lots of 100 acres.



A Township of 6 miles or 480 chains square divided into double Sections or Blocks of 1280 acres, and half quarter Sections of 80 acres.

Scale 200 chs to 1 inch

chain. Each quarter section thus had a road allowance on two sides of it and the owner was liable to be called upon to perform his share of the labor and expense of opening up and keeping in repair one mile in length of road. This was evidently a great tax, besides an apparently unnecessary waste of land. The system was again changed to the one now adopted, under which there is a road allowance of one chain in width around two sections. That is, every block of 1,280 acres is fronted with six miles of road. The long distance of two miles from one cross road to another will probably prove to be a decided inconvenience when all the lands are settled and properly fenced.

The system adopted by the Provincial Government of Ontario in that large tract of land lying between the Ottawa River and the Georgian Bay, south of French River and Lake Nipissing, has many features to commend it. The townships are subdivided into 1,000 acre blocks, and these again into lots of 100 acres each. Each block of 1,000 acres is fronted with five miles of road, and the distance from road to road on each side, the blocks being square, is 1 1-4 miles, or 100 chains. This distance is very convenient, and the tax of keeping up this length of road is found to suit the time and ability of the settlers.

It is to be noted that this system follows the decimal division, which is a decided advantage, whereas the division into sections of 640 acres departs from it.

Again, a quarter section, containing 160 acres, is usually too large an area for one man to cultivate properly. Eighty acres, or half a quarter section, on the other hand, is too small. One hundred acres has been proved by experience to be a very reasonable area to be allotted to one individual.

With regard to the numbering of sections adopted in the North-west Territories, the majority of people, and even surveyors, sometimes find it confusing. One has to keep in remembrance whether the numbers commence at the right or left, and whether at the top or bottom of the township, and that the numbering zig-zags up the township. Anyone not quite familiar with the system, or having constantly to refer to it, usually finds it necessary to construct or refer to a diagram in order to locate any desired section and the sections adjoining it.

In townships which are divided into concessions and lots, the same lot number goes through the whole township in one direction, and the same range or concession number across the township in the other direction. Any desired lot, and the lots adjoin-

ing it, can thus be instantly located. It appears strange that this excellent system of numbering, which was adopted for the ranges and townships in the North-west Territories, should not have been adhered to in the numbering of the sections within the townships.

For the purpose of description the subdivision of concessions and lots appears to have a slight advantage. For example, Lot 5, Concession 3, is a little better than the south-east quarter of Section 3. For the purpose of describing a road allowance, or a right of way for a projected road, railway or canal, there is also a little advantage. In the one instance a road allowance across a township is usually described as "the road allowance lying north of Sections 13, 14, 15, 16, 17 and 18"; in the other, "the road allowance between the second and third concessions." Similarly in the case of a right of way for a road, railway or canal; however, it is to be noted that there is no advantage in this respect if the right of way required passes diagonally through the township.

The subsequent cost to individuals of having the lines of their quarter sections or lots defined on the ground by survey is also a matter of consideration. In the case of the system of concessions and lots, when a surveyor is called upon to establish the boundaries of a lot of one hundred acres, he has to run the boundaries on its sides parallel to the governing line of the block, and produce them across the block in order to find their centres. These centres are then connected, making the rear boundary of the lot. This last operation may necessitate the running of a trial line, and a final line of each a quarter of a mile in length. The whole operation consists of the running of three miles of line.

In the case of the subdivision into sections, a surveyor, in order to define the limits of a quarter section, has to run two trial lines and two final lines, each one mile in length, or a total of four miles, or one mile of line more than in the subdivision into concessions and lots. If it should be required to define the limits of an 80 acre lot, or half a quarter section, half a mile more of line requires to be run, making four and a half miles in all.

It would thus appear that a desirable system of survey would be one comprising parts of each of the systems referred to, with the still further improvement of having all lines between lots run due north or south, as the case may be, instead of parallel to the governing line. This practice is now adopted by the Provincial

Government of Ontario in the surveys of the lands within the townships in the tract north of Lake Huron.

The principal meridians would be run, also the parallels of latitude or base lines. The chords would require to be 500 chains long, or rather 505 chains, including road allowances, instead of 480 chains, or 486 chains, including road allowances. The depth from base line to base line would also require to be made to correspond. A township would then consist of 25 blocks of 1,000 acres each, or a total of 25,000 acres, instead of 23,040 acres. Each block is divided into ten lots of 100 acres by lines drawn south from its north boundary, and north from its south boundary to its centre. There would thus be ten concessions in a township, 50 chains deep, numbered from 1 to 10, and 25 lots, 20 chains wide, numbered from 1 to 25.

DISCUSSION.

Mr. Ross—I think this is a very bright, clear and practical paper.

Mr. Van Nostrand—Mr. Chairman, I do not know that there is very much use in discussing this paper in detail. I am sure it is a very useful and valuable paper, and we will all read it when it is printed in the proceedings. When papers are read to us we do not always take them in just at first, and I think we will understand them better and get more good out of them after they are printed. I move that this paper of Mr. Bray's be received and printed in the Proceedings.

Mr. E. D. Bolton—I second that motion.

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SURVEY UNDER SEC. 38, SURVEYS ACT, 1897.

By G. B. KIRKPATRICK.

Toronto, February 22nd, 1900.

The parties to the action having agreed upon me, and having been appointed special referee under Order of date 20th April, 1899, pursuant to the provisions of cap. 64 of the Revised Statutes of Ontario, 1897, to determine the true definition of the boundary line between the lands of the plaintiff and the adjoining lands of the defendant as described in the patents from the Crown to them, and having made said survey, I thought it would be interesting to the Association of Ontario Land Surveyors to give an account of my proceedings, as the survey was made under a clause of "The Surveys Act" which very seldom occurs in a surveyor's practice and about which there has always been more or less confusion of ideas.

For obvious reasons I do not give the name of the Township.

I visited the site last summer and made diligent enquiry for any old men who resided in the neighborhood or elsewhere and who might be supposed to know something of the old survey.

Having obtained the names of at least half a dozen old men I visited them in their respective homes, but without eliciting any special information respecting the line in question.

I found from one old man, 82 years of age, that an oak tree had been used by the Boundary Commissioners a number of years before, and that this boundary commission had cut out one of the old blazes and ascertained that it was of the age of Augustus Jones' survey. The old man informed me that a stone monument had been planted by the said Commission a few feet south of the said oak tree; and I find on reference to the Department of Crown Lands that he referred to a Boundary Commission Survey made in 1839, and that the oak tree stood on the west side of lot number thirty-two on the line between the first concession and the broken front of township "S". On visiting the spot I found this oak tree in a perfect state of pre-

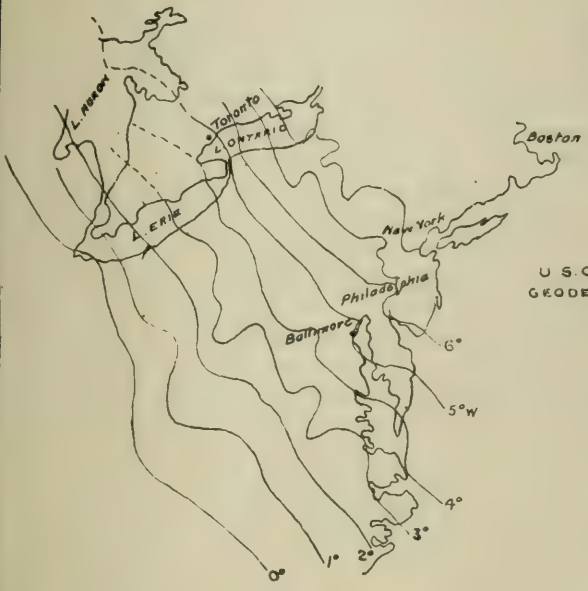
servation, but the old blazes had grown over. The stone monument, which the old man had informed me he remembered the Boundary Commission had planted, I found in exactly the position he indicated with the letter "B" cut on the top of it. I measured across from this oak tree along the Base line to side road between lots numbers twenty-six and twenty-seven in order to ascertain what the widths of the lots would be and how they would compare with the original survey.

Another old man whom I interviewed, who was also 82 years of age, and who has lived all his life in the vicinity of the survey I had to make, and who is in full possession of all his faculties, gave me a great deal of interesting information regarding the early history of the Township. He described a tree about ten inches in diameter at the time he knew it first, many years before which had blazes on it, but he could not say whether they were made by surveyors or not. Subsequently, however, I found my survey came out very close to the spot pointed out by the old man; and I found that Augustus Jones in 1828 had made a survey of one of the portions of land I was interested in, and think it very probable that the tree mentioned by the old gentleman, referred to this survey and not to the original survey of the Township.

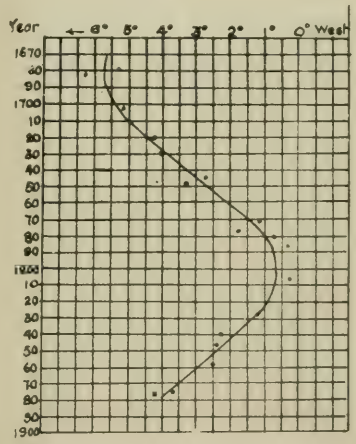
Finding that no reliable information could be got in the vicinity of my work, I turned my attention to searching for old boundaries further south on the line between lots numbers twenty-eight and twenty-nine, and, after diligent enquiry, was informed that there were stone monuments to be found on this line in the third concession and was given the name of a party who could possibly give me some information relative thereto.

I found a stone monument standing at the south-east corner of lot number twenty-nine in the third concession, marked evidently by a surveyor, bearing the following marks—"No. 29" on the west side, and "III" for concession three. The other sides were so weatherworn, portions of the stone having fallen out, I had no means of knowing whether there were any other marks on the monument originally or not.

Extending my enquiries I found that a party residing on lot number twenty-eight in the third concession knew something of the history of this monument. I found him at home and he informed me that he had been born on the lot; that his father had been born on the lot before him; and that his grandfather had owned the lot; and that having lived on the lot all his life he was familiar with the stone monument in question from the



U.S. COAST AND GEODETIC CHART 1890



Secular Variation of the Magnetic Declination, Baltimore Md.
Observed Declinations are shewn by dots
Computed " " " " curve

FROM JOHNSON'S SURVEYING PAGE 22

time he was able to run about (he being now 40 years of age). He stated that his father told him this stone monument with three others had been set many years before he was born and had always been recognized as indicating the true limits of the adjoining lots. He also informed me that the side road between lots numbers twenty-eight and twenty-nine in the third concession was in bush when he was a boy and that these monuments had been planted long before the side road was opened up. I obtained his affidavit as to the stone monuments planted at the south-east angle of lot number twenty-nine and at the south-west angle of lot number twenty-eight in the third concession, also as to the position of a stone monument at the north-west angle of lot number twenty-eight, and a stone monument at the north-east angle of lot number twenty-nine in the said third concession; these four stone monuments as he supposed and had always heard having been planted at the same time and by the same surveyor.

After a great deal of difficulty and delay I found an old man, in his 81st year, who was able to give me additional information as to these stone monuments, he being now the owner of lot number twenty-nine in the third concession having purchased it from the descendants of the original grantee from the Crown over 35 years ago. His evidence went to show that for many years prior to the date of his purchase he repeatedly saw a stone monument standing in the position it now occupies at the north-east corner of lot number twenty-nine in the third concession. He had never heard of any dispute as to this stone monument or the other stone monuments already mentioned, and that the owners of the lots had always recognized them as their boundaries.

I also obtained some corroborative evidence as to old stumps, part of the original forest, which agreed with the stone monument in question, showing that, when the survey by which the stone monuments were planted was made, the original forest had been standing, and presumably the marks made by the original surveyor were still visible.

This gave me two undisputed points in the line between lots numbers twenty-eight and twenty-nine, and I found myself then in a position to make the survey.

The original plan and field notes of Augustus Jones are on record in the Department of Crown Lands. Augustus Jones describes how he made the survey. The original instructions are not on record, but Augustus Jones states over his own hand "that he surveyed Townships No. 1 (Niagara) to No. 8 (Barton)

under instructions from Alexander Campbell, Esq., Major commanding the 29th regiment at Niagara. That he commenced Niagara 11th June, 1787, and surveyed the Township "8" in July, 1788. That when the Townships were surveyed the side lines of the lots were well marked with axes, the blazes on the inside of the trees next to the lines, except the line trees were marked with a blaze and three notches on two sides." By tracing out Jones' field notes I find that he ran the side lines of every lot in the township and that he ran the east limit of every side road allowance down to the lake on a course of north 18 degrees east, running the intervening lot lines up from the lake on a course of south 18 degrees west.

Under cap. 181, Revised Statutes of Ontario, 1897, Section 38, it is provided how surveyors shall act in those Townships in which the side lines of the lots were drawn in the original survey. Going back to the first Act to provide for ascertaining unknown boundaries in all cases in which the concession lines were not run in the original survey:

I find in Statutes of Canada, 20 Vic., cap. 73, page 356, (assented to 10th June, 1857) that the preamble gives a full explanation of the causes which led to the insertion of this Section in "The Surveys Act", which is as follows:

"Whereas the division or side lines of the lots in certain Townships in Upper Canada were drawn in the original survey, and the proprietors of the land have taken possession, and have regulated their improvements by such division or side lines; and whereas under the provision of the Act of 1849 intituled: An Act to repeal certain acts therein mentioned and to make better provision respecting the admission of land surveyors and the survey of land in this Province, Surveyors, in cases of dispute as to the boundaries of lots, are required with the view of ascertaining such boundaries, to measure the true distance along the concession line between the nearest undisputed posts, limits, or monuments and to divide such distance into such number of lots as the same contained in the original survey; but whereas, owing to the incorrectness of the original surveys of the Townships aforesaid, such subdivision does not agree with the division or side lines drawn in the original survey, and consequently the disputed boundaries cannot be decided to the satisfaction of the parties interested, and it is therefore necessary to provide a remedy: therefore Her Majesty, by and with the advice and consent of the Legislative Council and Assembly of Canada, enacts as follows:

"Notwithstanding anything contained in the Act before cited or in any other Act, it shall be lawful for Provincial Land Surveyors, and they are hereby required when called on to determine disputed boundaries in the said Townships, to ascertain and establish the division or side lines of the lots by running such side lines as they were run in the original survey, whether the same were run from the front of the concession to the rear, or the rear of the concession to the front thereof, in the original survey and to adhere to all posts, limits or monuments, planted on the division or side lines in the original survey, as being or designating corners of lots under such original survey".

I have no doubt in my mind that this Act was passed to govern side lines in those Townships from Niagara to Barton, No. 1 to No. 8 inclusive, as so far as I know, there are no other Townships in the Province to which such an Act would apply, these being the only ones I know of in which the side lines were run in contradistinction to the usual practice of running the concession lines in the original survey.

Having, therefore, as before stated, discovered two undisputed points on Augustus Jones' original line on the west side of lot number twenty-eight, in the third concession, I produced the same in a straight line down to the Beach Road along the Lake, then measured easterly along the north limit of the Beach Road, a distance of four chains, being the distance given in the License of Occupation, and then ran northerly, parallel to the above produced original line, a distance of three chains, to high water mark of Lake Ontario, driving in at each end of the said line to within eight inches of the surface of the ground an iron post one inch and a quarter in diameter, three feet long, forged at the top so as to shed the water, pointed at the bottom, and painted red, thus completing the survey in accordance with section 38 of "The Surveys Act of 1897".

An interesting feature in this survey was the comparison of the bearing of the old lines in Augustus Jones' time and the present time, Augustus Jones' survey having been made on magnetic courses.

I find that no observations were made at Toronto until the year 1840 when the variation of the Magnetic Needle was 1° 12′ west. It is now 5° west. I find on the plan of the Boundary Commissioners, above alluded to, dated 1840, that the variation is stated 30′ west.

From the observations in 1840 and 1899 it follows that the annual variation has been 3′.93 westerly.

I find that the earliest recorded observations show that the north end of the Needle was moving east in 1670 and continued to do so until near the close of the Eighteenth Century. From determinations made at Buffalo, Erie, and Cleveland and other places further east, Mr. Stupart, Director of the Meteorological Service, Toronto, calculates that the most easterly declination at Hamilton occurred about 1795 when the Agonic line or line of 0° declination passed near Toronto. In 1788 the Agonic must have passed very near Hamilton and slowly worked eastward until 1795 when it attained its most easterly position passing near Toronto, during which time the Needle will have been moving east to Hamilton. A westward movement then began and in 1800 the Agonic again passed nearly through Hamilton.

From the above deductions it will be seen that in 1788 the declination at Hamilton was 0°, the compass pointed true north.

I find the above to agree exactly with my observations, the course of the side line between lots numbers twenty-eight and twenty-nine being north 22° east, or 4° west of what the compass read in 1788. The variation at Hamilton being 40′ less than at Toronto it follows that the variation is 4° 20′ west showing as close an approximation as the compass of a six inch Theodolite will permit of.

I may say that my survey was promptly confirmed by the High Court of Justice and apparently all parties are quite satisfied.

I append hereto a sketch from the United States Coast and Geodetic Chart, 1890, showing the secular variation at Baltimore from 1670 to 1890, which was kindly furnished to me by a brother surveyor.

DISCUSSION.

Mr. P. S. Gibson—I understand, Mr. Kirkpatrick, that you checked your line with that tree?

Mr. Kirkpatrick—It was practically correct.

Mr. Ross—Mr. Kirkpatrick has given us a peculiarly interesting paper. There are other Townships similar to the ones he mentioned. I know of a county in which the side lines of the first eight lots were run from north to south in the original survey, and some of the lots are narrowed down. In this case the concession lines are crooked, and in some of the townships you

could not tell how they were run except that you will find that peculiar shape of lots—lots narrowed down ; the sidelines are straight and the concession lines are crooked. Take, for instance, the Township of Crowland, where for the first eight lots the side lines were run; then on the remaining twenty-five or thirty lots the concession lines were run. I would like to ask Mr. Kirkpatrick: what would be the governing line in this case, the town line nearest to Lot 1, or the last side line run?

Mr. Kirkpatrick—The Niagara District is one of the most difficult places to survey that we have in the province. If any surveys were required now, I suppose that almost everybody would be found to hold their lots by possession. In making the surveys in the Township of Grantham I think Mr. Passmore placed stone monuments, and he measured along the lines as they were run.

Mr. Niven—There were no concession roads run; then the concession lines were established by joining the points on the side roads, so that the concession roads are very crooked. In Niagara I think what they call concession lines were run, and also side lines; there are two lots between every two side roads; then they divide the space between the side roads, front and rear, and join the points. Almost all these townships have a custom of their own. Mr. Kirkpatrick has done well to bring this to our notice, because the system of survey is very difficult to understand. Although in the examinations I notice that nearly all the students that come up can quote the Act as to this system, yet they have not the faintest idea of what it means.

I have much pleasure in moving a vote of thanks to Mr. Kirkpatrick for his paper.

Mr. Aylesworth—I am very glad, indeed, to have heard the explanation of Mr. Kirkpatrick on this part of the Act. I remember when I was practising I was asked what that section meant, and I had to say that I did not know.

The President—This paper of Mr. Kirkpatrick's will be very valuable. As years go by it can be referred to when all these matters have been forgotten. The young surveyor can, by looking over the index, find out what perhaps would have taken him years to find out. Our members might prepare papers on townships coming under their observation in the course of their practice which have peculiarities such as the ones in question.

I have recently made a survey in the Township of North Dumfries. I believe there is no plan on file anywhere showing how the township was surveyed, and I had to enquire a good deal from the oldest residents to find out where the original lines were run. I found that the township was surveyed as a single front township; the lines were run from the front of the concession; previous to that I did not know but that it might have been a double front township, or what it was; but I found that all the original stakes were still there. This is a township that must have been surveyed very early in the century—

Mr. P. S. Gibson—By the Government?

The President—Owned by a private individual, the Hon. Mr. Dickson, and it was sold by him. Some parts of it have remained in that family's hands up to the present day, right where the Town of Galt is situated. I have had to go to considerable trouble to straighten out some plans in the Registry Office that had titles, calling for lots Nos. 10 and 11 in a certain concession, while as a matter of fact these lots were not in existence at all. The owner had laid out sub-division lots fronting on the Grand River; so the titles had to be changed to sub-division lots in this concession instead of the original lots that were supposed by one surveyor to have been laid out, and which must have got into pretty bad shape in the Registry Office. There should be some means taken very soon—the sooner the better—to put these original surveys in better shape, because as time goes on and the old settlers pass away there will be less and less known of the original surveys.

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FOREST TREES OF ONTARIO.

By W. A. McLEAN.

The professional value of a scientific knowledge of our forest trees has been in past years discussed by the Association, and the subject of "Botany and Forest Flora" has been placed on the list of subjects for examination—this largely for the purpose of requiring such an acquaintance with our forest trees as will enable the surveyor to name them correctly.

I have assumed, correctly I have no doubt, that most of you know more about the subject than, perhaps, you are aware, and that a brief outline of the trees of the Province will merely convey to you the information that you know it all, which of itself will be of some value. At any rate, in the great majority of cases there can be little doubt as to the genus to which the tree belongs; that is, whether it is an ash, oak or elm, although there may be frequent uncertainty as to the species.

Again, while we may, without much uncertainty, be able to properly name the majority, there will be an element of safety in a doubtful case if we can classify the tree not merely because of its own characteristics, but as well because we know that it cannot be anything else, which is possible only when we have a knowledge of all the trees it might be.

The list of native trees is not a very lengthy one, but may be found difficult to prepare from the sources available. Transition from the herb to the shrub and from the shrub to the tree is so gradual that the botanist is forced to disregard the distinction in his primary classifications, and so dependence is placed on the flower and method of seed production. So it is that we find, in the botanist's classification, trees obscured among a mass of herbs and shrubs. The nettle is placed beside the elm, the strawberry is in juxtaposition to the black cherry; and a mass of herbs and shrubs intervenes. There are no distinctly Canadian or local text-books on forest trees alone, and general works are apt to be confusing, including as they do many trees which do not grow in this Province.

The most practical means of distinguishing trees are found in the leaf formations, the bark, the fruit, the size and general aspect of the tree. The leaves vary as to size, shape, texture, color; some are smooth, some are rough, downy or hairy, and the margin may be entire, toothed, wavy, regular or irregular, and many other forms. The bark varies as to color, thickness; it may be smooth or rough in different ways, and sometimes has a characteristic taste or odor. The fruits and the size and aspect of trees of different species exhibit equally numerous variations. It should, however, be understood that none of these characteristics are constant for every tree of a particular species. There are exceptions to many, if not all, rules, even in botany. The comments which accompany the list indicate the most prominent distinguishing marks having reference to other trees with which they are likely to be confused, and from a practical standpoint.

In order to obtain a completely satisfactory knowledge of forest trees some acquaintance with botany is necessary. Otherwise one's knowledge and the use to which it may be put must remain very local, and cannot be carried to other countries. For example, I may point out that of some 109 coniferous trees native to the United States, eighty are found west of the great plains, twenty-eight belong to the eastern forests, and only one is common to both. But with or without an acquaintance with botany, a study of our own trees, and consultation with available works on the subject, will be much simplified by having a complete, or approximately complete list of the trees we may expect to meet. A knowledge of such a list as follows may be had without much, if any, study of botany, but in extending our knowledge to shrubs, herbs, and to the trees of other countries botany is the only convenient medium.

The most important timber trees of the Province are contained in the botanical order *Coniferae*. This is the single Canadian order of a class in which the ovules and seeds are not enclosed. It includes all of the cone-bearing trees, and there is but one species, that a shrub, which cannot be described as cone-bearing. The trees of the order are:

Pinus Resinosa (Red Pine).
Pinus Strobus (White Pine).
Pinus Banksiana (Jack Pine).
Abies Nigra (Black Spruce).
Abies Alba (White Spruce).
Abies Canadensis (Hemlock).

Balsamea (Balsam).
Larix Americana (Tamarack).
Thuja Occidentalis (Arbor Vitae, or White Cedar).
Juniperus Virginana (Red Cedar).

The pines may be best distinguished by their needles or leaves. The white pine has five in a bunch, from three to four inches long. The needles of the red pine grow in pairs, but are five to seven inches in length. In the jack pine the needles grow in pairs, and are scarcely an inch long. At a distance the red pine has a sharper outline than the white pine, while the bark has a ruddy cast. The jack pine has a stunted appearance, is often scarcely more than a shrub, and rarely attains a height of thirty feet.

The spruces may be distinguished from other evergreen trees by their short, four-sided leaves, pointing in all directions. Leaves of the white spruce are curved, rather slender, and of a bluish green. Leaves of the black spruce are generally straight and stiff, and of a darker green than those of the white spruce. The bark of the black spruce is also darker than that of the white spruce. The cones of the black spruce are a broad oval, while those of the white spruce are not so thick in proportion to their length.

The Hemlock has blunt, flat, short (about one-half inch) needles, a dark, lustrous green above, and whitish beneath. Its boughs spread out, plume-like, drooping, while the cones are very tiny.

The Balsam has slightly longer leaves than those of the Hemlock. They are flat, blunt, straight, a dark-blue green above and lighter below, and grow in two directions from the branch. The small branches are opposite one another, and make an angle of 45 degrees with those on which they grow. The cones are two to four inches long, and the bark is marked with blisters containing the well-known balsam.

The Tamarack may be known by a glance at the ground beneath it, which will be thickly carpeted with the brown deciduous leaves. The leaves grow in bunches along the stem, and the cones are very small. The tree has an extraordinarily tall and thin appearance.

The cedars are found chiefly in southern Canada. White cedar has a bright green leaf spray, and the fruit a cone. Red cedar is dark-hued, compact, the leaves smaller than those of white cedar, and the fruit a bluish-gray berry.

The order *Salicaceae* includes the willows and poplars. Of willows there are some eight well-defined species, but there are so many hybrids, and so many have been introduced from Europe, that they are difficult of classification. They are unimportant as trees, although one or two varieties occasionally reach a height of twenty or twenty-five feet, but they may generally be classed as shrubs. With the exception of one species they are generally found in moist or boggy land. Their narrow leaves and slender branches are distinctive. One variety, salix alba, or white willow, is of foreign origin, but has become so common that we may almost consider it naturalized.

The more important trees of the order are the poplars, which are :

Populus tremuloides (White Poplar or Aspen).

Populus grandidentata (Large-toothed Aspen).

Populus balsamifera (Balsam Poplar).

The aspen, or white poplar, may be recognized by its tremulous foliage, due to the thin, flattened leaf-stems. The leaf of the white poplar is smaller than that of the large-toothed aspen, and is slightly heart-shaped; and the bark is smooth and greenish white. The leaf of the large-toothed poplar has, as the name indicates, its margin more prominently toothed, and the outline is more of an egg shape. The bark is inclined to be darker and rougher than that of the white poplar, and on the young branches is quite dark. The white poplar may readily be mistaken for the gray or white birch, but the birch has an exceedingly brilliant light green foliage, which reflects the sunlight, while the aspen has a whitish foliage, which is not at all shiny. The leaf of the balsam poplar is very different from that of the other two. The leaf-stem is thicker, so that it does not tremble, and the leaves, which are firm and thick, are held erect on the twigs. Their color above is a yellowish green, although whitish below like the other poplars. The buds are gummy, with an agreeable balsamic odor. A number of European poplars have been introduced, which have become very common, notably the silver-leafed poplar and Lombardy poplar.

The order *Betulaceae* includes four well-known trees:

Betula lenta (Sweet, Black or Cherry Birch).

Betula lutea (Yellow Birch).

Betula papyrifera (White Paper or Canoe Birch).
Betula populifalcia (White or Gray Birch).

The first of these, black birch, has a brown bark, and the twigs have a pleasant aromatic flavor that is sufficiently distinctive. The yellow birch has an unmistakable yellowish cast that prevents its confusion with other varieties. The outer bark curls up in thin, satiny tatters, giving the trunk a slightly ragged appearance. The white birch has a distinctly light, airy appearance, and in the sunlight the leaves reflect a dazzling brightness. Under each bough where it joins the trunk there is a characteristic triangular brown patch. The white bark does not easily separate into layers, and, unlike the canoe birch, is apt to be knotty. The canoe birch is well known by its bark, so easily separable into large sheets unmarked by knots. It need not be confused with the white birch, as the trunk is scarcely marked with the triangular patches to which reference has been made, while with the white birch they are never absent. The bark of all members of this order has a characteristic dot and line marking.

The order *Cupuliferae* is prominent, including the several species of oak, chestnut and beech. The cup or burr which surrounds the nut is a prominent characteristic of the order, the trees of which are :

Quercus alba (White Oak).
Quercus macrocarpa (Burr Oak).
Quercus bicolor (Swamp White Oak).
Quercus rubra (Red or Rim Oak).
Quercus coccinea (Scarlet Oak).
Quercus coccinea, var. tinctoria (Black Oak).
Castanea vesca var. Americana (Chestnut).
Fagus ferruginea (Beech).
Ostrya Virginia (Ironwood or Hop-Hornbeam).
Carpinas Americana (Blue Beech or Hornbeam).

The oaks are difficult to classify owing to the presence of a number of hybrids, and also the importation of European varieties. Those enumerated are probably the only distinct varieties found in Ontario. The acorns of the first three mature in one year, those of the three last varieties maturing in two years.

The chief distinctions are :

Variety.	Leaf.	Bark.	Acorn.
White Oak....	Rather deeply lobed, turning to rich red in autumn.	Grey, not very rough, tinged with brown.	Rough, cupped, generally in pairs.
Burr Oak	Deeply lobed and very long, turning dull yellow in autumn.	Deeply furrowed, young branches marked with corky ridges.	Heavy fringe at edge of cup. Usually solitary.
Swamp White Oak.....	Wavy outline, resembling that of chestnut, yellow in autumn.	Flaky bark, and small, crooked branchlets hanging from heavy limbs.	Rough, rounded cup, with a bristling, rather than fringed, edge, frequently in pairs on a long stem.
Red Oak	Bristle-tipped, turning a dull red in autumn, not deeply lobed.	Dark gray-brown surface of scaly plates.	Saucer shaped, not large.
Scarlet Oak ...	Deeply rent, having a ragged appearance, red in spring, green in summer, turning to red in autumn.	Thick, brownish, roughly seamed.	Thick, top-shaped cup, covering one-third of nut.
Black Oak	Deeply incised, turning to rich red in autumn.	Dark, often blackish.	Acorn small, but very yellow.

The beech and chestnut are too well known to need description. The hornbeams are apt to be confused with the beech, but are smaller trees with furrowed trunks and a different fruit. The blue beech has a greyish blue smooth bark, often marked by perpendicular ridges. The fruit is a nut, protected by two small three--pointed leaflets placed base to base The hop-hornbeam has a fruit resembling the hop, the bark is rather rough, a brown or dark grey, and is finely furrowed up and down, with the ridges broken into three and four inch lengths.

The order *Juglandaceae* is well known, comprising :

Juglans cinerea (Butternut).
Juglans nigra (Black Walnut).
Carya alba (Shell-bark Hickory).
Carya tormentasa (Black Hickory).
Carya porcina (Pig-nut Hickory).
Carya microcarpa (Small-fruited Hickory).
Carya amara (Swamp Hickory).

The butternut and walnut may at once be distinguished by the nuts; also by the petioles (or leaf stems); these in the former case being very sticky, with a horse-hoof base, and in the latter slightly downy, one to two feet in length, and without the horse-hoof base.

The shell-bark hickory, the most common of the genus, may be known by its gray, loosely-attached bark hanging in strips a foot or so long and six inches wide. The leaflets on a stem are five in number. The husk of the nut is thick and hard, and splits into four separate sections. Black hickory (C. tormentosa) has from seven to nine leaflets on a stem. The nut is large, fragrant when bruised, thick shelled, with a thick husk, but the kernel is small. Pignut hickory (C. porcina) has from five to nine leaflets on a stem. The fruit is sometimes pear-shaped, otherwise oval, and has a thin husk which clings to the nut, falling with it to the ground. The small fruited hickory has a small round nut free from angles, with a thin husk which splits open almost to the base. The leaflets are usually five, sometimes seven, on a stem, and the bark is rough, separating into thin, narrow plates. Swamp hickory has from seven to eleven narrow leaflets on a stem. The husk, enclosing a rather soft, roundish nut, is thin, and separates only half way down. The kernel, at first sweet, becomes exceedingly bitter.

The order *Platanaceae* is represented by one species, Platanus occidentalis, the plane tree, button wood or sycamore, a handsome tree, found only in south-western Ontario.

Of the elms belonging to the order Urticaceae (the nettle family), sub-order Ulmaceae, there are two varieties:

Ulmus fulva (Red or Slippery elm).

Ulmus Americana (White or American Elm).

The former is a medium-sized tree, with leaves very rough above and taper-pointed; the latter the larger and more handsome of the two, with arching branches, smaller leaves, smooth above and abruptly pointed.

The order *Lauraceae* is represented by one variety, Sassafras officinale, a tree of moderate size, growing in southern and western Ontario, which may be known by its strongly aromatic flavor.

The Olive family, order *Oliacea*, has three representatives:

Fraxinus Americana (White Ash).

Fraxinus sambucifalia (Black Ash).

Fraxinus pubesceus (Red Ash).

The first two may be distinguished from one another by their leaflets, those of the former having stalks, and those of the latter being sessile. The first two have smooth, glaborous petioles and branchlets, while those of the last (red ash) are covered with a soft down.

The Cornus florida, or flowering dogwood of the order *Carnacea*, is a small tree found in south-western Ontario. Farther south it increases in size, and is one of the woods known as boxwood. The flowers are large, dull white, the leaves from three to five inches long, and the fruit a bunch of bright red berries.

Of the order *Magnoliacea* there is one species in Ontario, the tulip tree (Liriodendron tulipifera), a tree found in the western peninsula, and assuming very stately proportions. The leaf is cut off in a peculiar manner at the end, by which it may at once be recognized.

There is but one tree of the order *Rosaceae* (Rose family) deserving of classification among timber trees, yet there are other small trees, at times little better than shrubs, which may be enumerated. The trees of the order, then, are:

Prunus serotinta (Wild Black Cherry).
Prunus Pennsylvanus (Wild Red Cherry).
Prunus Virginiana (Choke Cherry).
Prunus Americana (Wild Plum).
Crataegus coccinea (Scarlet-fruited Thorn).
Crataegus tormentosa (Black or pear thorn).
Crataegus coccinea (Dotted-fruited Thorn).
Crataegus crus-galli (cockspur thorn).
Pyrus coronaria (American Crabapple).
Pyrus Americana (Mountain Ash).
Amelanchier Canadensis (June Berry).

The one important tree of this order is the wild black cherry, to be distinguished by its size, its small black fruit, and the bitter almond flavor of its bark. The choke cherry is but a good-sized shrub, and the fruit is very astringent. The red cherry has a very sour fruit, but otherwise resembles more the garden cherry. The bark, like that of the garden cherry, has swollen, rusty-colored spots, and usually strips around the trunk. The wild plum has a yellowish orange-colored fruit, oval in form, a thick acid skin and pleasant flavor. The thorns are somewhat without the limits of this paper, as they are unimportant and scarcely more than shrubs. The remaining trees of the order are well known, and there is not likely to be any doubt as to their identity. Except,

perhaps, the June berry, a tree somewhat resembling the black cherry, except that it is never more than thirty feet high, is slender, drooping, and has a sweet, purplish fruit, ripening in June.

The maples belong to the order *Sapindaceae*, and there are five species of importance:

Acer saccharinum (Sugar Maple)
Acer rubrum (Red Maple).
Acer Dasycarpum (White or Silver Maple).
Acer Pennsylvanicum (Striped Maple).
Acer spicatum (Mountain Maple).

The last of these is a shrub, growing in clumps on low grounds. The first two have leaves three to five lobed, the lobes of the sugar maple being rounded, those of the red maple being sharp pointed. The twigs of the red maple, too, are of a reddish hue. The leaves of the silver maple are deeply and sharply five-lobed, and silvery white beneath. The striped maple has a light greenish bark, with dark vertical lines ; is a small tree, seldom growing over twenty feet in height, the leaf being large, thin and three-lobed at the apex. In addition to the foregoing species a few others are sometimes met in cultivation.

Basswood or whitewood belongs to the order *Tiliaceae*. The one Ontario variety is Tilia Americana, which is a very handsome, straight tree, the large, strikingly heart-shaped leaves (four to six inches long) being a sufficient means of identification. The fruit is distinctive too, resembling a bunch of elongated brown peas. Another species, Tilia pubescens, a small-leaved basswood, may be looked for in Southern Ontario.

Of the locusts, order *Leguminosae*, there are two varieties:
Robinia pseadacacia (Common Locust).
Robinia viscosa (Clammy Locust).

The latter is the smaller of the two trees. The chief distinction is that the leaf stems and branchlets of the clammy locust are sticky, and the flowers erect, rose tinted, and scarcely fragrant. The branchlets and leaf stems of the common locust are not sticky, the flowers are drooping, white and very fragrant.

The staghorn sumach (Rhus Typhina), order *Anacardiace*, is so well known as to need no description. To this order belong poison ivy and one or two other shrubs found in Ontario.

Other trees, small and unimportant, which we may expect to meet are:

Celtis occidentalis (or Sugarberry).

The fruit of sugarberry is single seeded, sweet, about the size of a currant, purple when ripe, and solitary on a long stem in the axles of leaves; tree from a shrub to fifty feet.

Sweet ruburum may be known by its blue-black, sweet fruit, growing in clusters and ripening in autumn.

Viburnum lentago (Sweet viburnum).

Negundo aceroides (Box Elder or Ash-leaved Maple).

Morus rubra (Red mulberry).

The foregoing list of sixty-eight species includes the principal trees of the Province. There is, as I have said, no well-defined line of demarcation, however, between herbs and shrubs, shrubs and trees. In consequence I have no doubt included some varieties which scarcely deserve to be classed with the forest trees, and have no doubt omitted some which, in importance, are equally deserving of mention. There has been method in the madness, however, and I have endeavored not to trespass except where it has seemed advisable for a clearer identification of the trees of importance.

A discussion of the distribution of these trees would fill a volume, but may be here briefly noted. Beginning with the most northerly portion of the Province, bordering on James Bay, we find little but spruce and balsam poplar. Further south the first additional trees we meet are the jack pine and the aspen (populus tremuloides). Further again, and we are among the forests of white pine, red pine and hemlock; and our next step brings us well among the broad-leaved trees, the oaks, maples, elms and beeches, till at last, in the most southerly portions of the Province, we are among trees of an almost tropical aspect, the tulip tree, sassafras and sycamore. Were we to continue our journey still to further south, the task of merely studying tree names would increase many times. So that if we have not the great variety of trees to be found in the Southern States we are spared the labor of making their acquaintance; and with our immense areas of pine, spruce and hemlock there is none we need envy.

The title selected for this paper suggests a distinction. At some risk let me point out that "forest trees" is but a branch of "forestry." The former is but the gateway to the other—to a very wide but interesting field. The latter and broader

scope has been brought before the Association in several valuable papers by Mr. Southworth, Director of Forestry.

While the more prominent characteristics of the different trees have been stated, there are many others which could not find place in so brief a paper. The literature of trees is, however, a very wide one. In continuing a study of Ontario trees, the works which have appeared to be most serviceable are: "The Trees of North-eastern America," by Newhall, and "Familiar Trees and Their Leaves," by Matthews. An introduction to botany may be had by reading a few chapters of Spotton's "Botany." The subject of Forestry in its economic aspects is being fully discussed from time to time in the reports of the Ontario Bureau of Forestry; and I may suggest "North American Forests and Forestry," by Bruncken, as a very readable and recent book on the question.

[This Association is not responsible as a body for the opinions expressed in its Papers by Authors.]

ARTESIAN WELLS.

By A. J. McPHERSON.

There has always been a certain amount of mystery in the popular mind connected with the location and movements of underground water and we have all observed with what reverence one of those old diviners is held as he goes about with a forked branch of a tree until he finally stops at the place where he pretends is the proper spot to look for water. The wizard-like abilities of Major Girouard could not be regarded by the natives of an Egyptian desert with more superstition as he constructed his line of railway and obtained water at suitable intervals simply by putting down wells where for ages there was nothing but a sandy waste. When we come to consider the conditions under which these supplies of water exist, however, all this mystery disappears and, at the present time, it can be told with certainty in many cases what sort of water supply may be had from these sources.

There are two classes of water from which our Ontario Towns and cities generally obtain and look for their water supply. Those on the shores of our Great lakes and rivers naturally go to these reservoirs and the only difficulty is to find the place where the water can be obtained pure and unlikely to be contaminated in the future.

Inland towns must look to underground sources and to lakes and streams fed by underground sources for their supplies. Most of the rivers in Ontario are short and the lands around their sources have been denuded of their forests so that they have become very small streams in comparison with what they once were, except when a heavy rainfall occurs or during the spring freshets when they suddenly become roaring torrents with muddy water carrying all sorts of debris and often doing great damage along their banks.

The dry weather flow of these streams is almost all kept up by the many springs running into them along their banks and where the beds of the streams are so high as to be above the

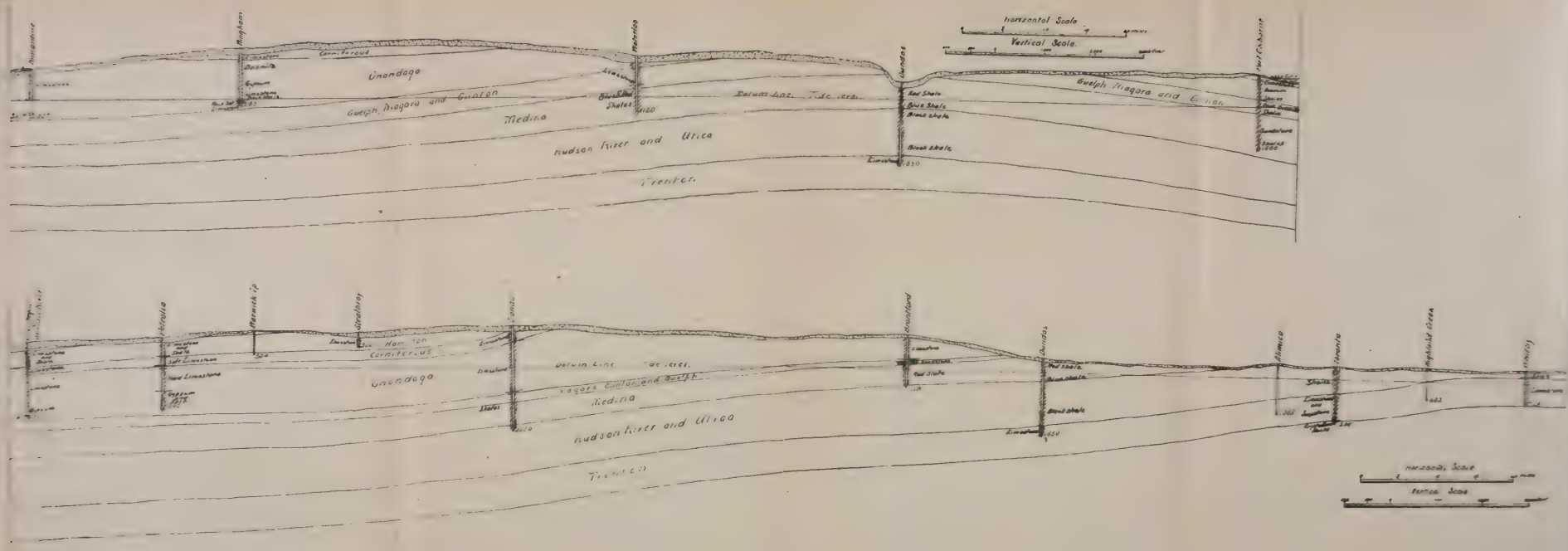
lowered ground water they dry up altogether during this season. As these rivers are becoming more and more polluted with sewage and waste matters, for which they are often considered the natural means of disposal, they cannot be taken as a source of water supply.

The first source from which villages and towns usually obtain their domestic water, and on which many of the smaller towns still depend, is the old fashioned pump and well, dug or drilled to the necessary depth to act as an accumulator from the immediately surrounding district. As the area gets built upon and population increases these wells become little better than cesspools into which the waste matters of the district must drain and to which can be traced many of the epidemics of typhoid, scarlet fever, and other preventable diseases. Any flow of water depending on a small drainage area, as in the case of these wells, must of necessity be limited in quantity and many of them dry up annually and cannot be depended upon for a supply throughout the year.

A very prevalent opinion is that in sinking a well one must go down to the level of a lake or some stream but so far from this being the case, as was noted above nearly all these lakes and streams are fed by springs which are nothing more than the outcrops of underground reservoirs and if a stream or pond does not dry up at any time during the year water ought to be found at some distance above this level in the surrounding district, the farther away, depending on the strata, the higher above this level.

In a section of the Wisconsin Experiment Station in a sandy clay and clay loam with boulders interspersed, the ground water surface during a time when there was no extraordinary rainfall, was found to have an upward grade away from the lake into which they naturally discharged, of about 1 in 16 so that at a distance of 200 feet from the lake the ground water surface was 12 feet, and at a distance of 1200 feet it was found to be 52 feet above the lake level, the latter giving a grade of about 1 in 23.

This ground water surface rises and falls as the rain fall is great or small and acts as a regulator for the springs supplied. In an experiment noted in the nineteenth Annual Report of the United States Geographical Survey, columns of sand 8 feet high with sand grains of different sizes, after having been put in an apparatus designed to prevent evaporation, were saturated and allowed to drain with the following results:


Horizontal Scale
Vertical Scale.
Onondaga
Guelph, Niagara and Guelph
Medina
Hudson River and Utica
Trenton
Corniferous
Hamilton
Corniferous
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Amount of run-off.	From sand.	Was per cent. of the weight of the dry sand.
For the first nine days	No. 20	14.98
" " "	No. 100	8.42
After nine days till two and a half years	No. 20	1.61
	No. 100	1.26
Amount retained after draining, two and a half years	No. 20	4.24
	No. 100	11.82
Total amount when saturated	No. 20	20.83
	No. 100	21.50

NOTE.—No. 20 sand is sand that will go through a No. 20 Sieve, but not through No. 40. No. 100 sand is sand that will go through a No. 100 Sieve.

The lower foot of both the No. 20 and No. 100 columns were almost saturated at the end of two and one-half years while the surface foot of the No. 20 sand retained about 0.25, and of the No. 100, 3.5 per cent. of the dry weight showing them to be very dry indeed.

This experiment well illustrates the capacity of soils for retaining moisture and of allowing a slow seepage to take place thus giving a constant flow to springs and underground supplies. Clay loams and clays retain their water much longer than these sands as we would expect when it is stated above that the fine sand acted thus, and consequently produce a more constant seepage.

An idea of the amount of water that is stored in these reservoirs may be had by considering the following:

When below the drainage outlet, and hence saturated, 12 inches of

Marly loam was found to contain	5.88	inches of water.
Red Clay " " "	5.07	" "
Sandy Clay " " "	4.67	" "
Fine Sand " " "	3.76	" "

Except in the very driest times soils and rocks contain about 75 per cent. of the amount required for saturation when below the surface more than 4 or 5 feet, even when considerably above the ground water level.

In Ontario the rainfall may be taken to average from 30 to 40 inches annually.

About 50 per cent. of this amount will generally evaporate or run off on the surface while the remaining 50 per cent. will sink into the soil, some of it to be taken up by the roots of plants, some held in the ground by capillary action until it evaporates or is taken up by roots, and the remainder goes to swell the ground water reservoirs.

Assuming 25 per cent. of the rainfall to sink to these ground waters or about eight inches annually one acre will provide a

daily flow of 181,500 Imperial gallons and when we remember that the configuration of the ground enables areas some-times miles in extent to minister to the supply of a few springs it is not surprising that they give a large and never failing quantity throughout the driest seasons.

Many towns develop these outlets in various ways by collecting the outcrops in galleries or wells from which they may be led or pumped as required.

Guelph, Orangeville, Owen Sound, N. Toronto, Galt and other places obtain their water in this way. When a permeable sand or gravel occurs over a wide area and the strata are found to dip, as they generally do, in many cases we will find on their lower reaches an impervious or comparatively compact deposit on top and if the upper layer is pierced by a drill hole the water is shown to be under pressure and will rise above the surface or near the surface above the level of the ground water. A number of towns have availed themselves of these conditions and have abundant supplies of water as the result. These waters are drawn from a wide drainage district through channels that are partly capillary and partly obey the laws of flow, in larger than capillary channels for long distances, and hence are absolutely pure from a sanitary stand-point. They are found sometimes to be objectionably impregnated with mineral matters or so hard as to require treatment before becoming a good commercial water. Aerating in all cases is necessary and is generally all the treatment required. Data from towns supplied in this way from sources that are not down to rock-level.

Place:	Depth of Source: Feet.	Water rises to ? above or below surface.	Bore of well. Inches.	Quantity available. Imp. gal. per hour:	Material drilled through.
Essex.....	112, 135	25 ft. below surface.	5 and 8	1,500	Clay 100 ft. hard pan, 3 or 4 ft. coarse gravel, rock.
Leamington.	50	10 ft. above	8	.....	10 ft. of sand and clay, sand and clay to gravel:
Shelburne....	450	50 ft. below	5	.....	100 ft. quick-sand, clay and marl to water at rock.
Barrie.....	125	12 ft. above	4	1,440	20 ft. sand, 60 ft. sand with thin layers hard pan, 3 or 4 ft. hard pan gravel:
Newmarket..	150, 265	Above and flow into well	4, 5 and 6	500, 1,250	Hard pan and quick-sand to water-bearing gravel.
Berlin.....	116	7 ft. above	8	2,000, 6,500.	145 ft. sand and clay, 5 ft. hard pan, 8 ft. gravel; varies in ten wells from this slightly.

A well sunk by Mr. Savage in Berlin showed the surface to be 187 feet above lime-stone rock.

In every case the water bearing stratum is loose gravel or sand. In 1895 the Town of Galt deemed it prudent to increase their supply and drilled through lime-stone rock from the surface to a depth of 140 feet when they encountered a very porous and much fissured lime-stone which yielded from a 6 inch well about 100,000 gals. per diem. at the surface of the ground. This water would rise about 3 or 4 feet above the surface to a point a little below the outcrops of the lime-stone rock along the sides of the Grand River Valley in which the pump house was situated, the springs which were developed as aforesaid outcropping at the surface of this rock and being collected in a well convenient to the pumps. In 1896 another 6 inch well was put down and a similar quantity of water was obtained at about the same depth in a similar rock. This rock was penetrated about 40 feet further, 30 feet of which was water-bearing and the flow from the well was by this means increased to about 300,000 gals. per diem. and the water would rise above the surface to about the same height. These wells would appear to be fed from an area where this fissured stratum came to the surface or where it might receive the ground water through the surface deposits on top of the rock, and received the pressure sufficient to raise them above the surface by having superimposed layers of more compact lime-stone above the water-bearing stratum. The temperature of the water discharged from the wells is 46° and that from the springs 48°. The former remains constant while the latter will lower about 1 degree during March and April.

In 1899 a well was dug in the same vicinity with the object of getting sulphur water, to a depth of 200 feet or more but as it was commenced nearly as high as the rock outcrops along the valley the water obtained would not rise above the surface.

St. Mary's derived a supply in 1899 by drilling in lime-stone of similar formation to that of Galt.

At Preston sulphur water is met with and will flow out above the surface from a depth of about 120 to 150 feet below the surface of the rock.

There have been practically no explorations for water in the lower rocks although quite a number of wells have been sunk in different parts of the Province for salt, oil and gas.

At a well sunk at the London Asylum the following is the record of the drilling:

	Feet.
Surface	130
Corniferous limestone	200
Guelph and Niagara (Onondaga) limestone	970
Salt and Shale (Onondaga)	100
Black Shale (Clinton)	200
Red Shale (Medina)	500
Hudson River limestone and shale	150
	2,250

As nearly all these formations are lime-stone which are very poor water carrying media, except when very porous, the most successful explorations for water appear to have been made and would be most likely in the upper strata or within the surface deposits while by boring deeper we are likely to get water tinged with salt or some other minerals in the Western peninsula of Ontario.

Two sections across the Western peninsula, as given in the Annual Report of the Geological Survey, Vol. 5, 1899-'90-'91, and which were made from observations collected from a large number of salt, oil and gas wells sunk in different parts of the district, admirably show the strata underlying this portion of the Province.

The conditions are such that we might expect water to flow to the surface from porous strata of lime-stone or sandstone in the district west of Strathroy while east of this the water would not come to the surface unless in the comparatively deeply eroded river valleys that sometimes cut considerably into the rock strata.

The great depth of the surface deposits over much of the Province seems to indicate, however, that they are the most promising field of exploration for potable water that may be used for commercial and domestic purposes and they certainly contain an inexhaustible supply in places where it can be made available.

It is with considerable diffidence that the foregoing is submitted as I find that the subject is practically an unexplored field and there is very little literature or data that will apply to the Province. However, there may be a number of the members who are interested in the subject and may have made a study of it and I may look to them to criticize and correct any statements that may seem to be not borne out by the facts.

DISCUSSION.

The President—As Mr. MacPherson states, I think this is one of the first papers to deal with artesian wells as occurring in this province, or rather dealing with the development of underground waters. It is mentioned in the paper that the Town of Berlin has an artesian well water supply. The original water supply there was a little pond, which was very soon dried up, and since that time about a dozen artesian wells have been put down, most of them eight inches in diameter, going down an average of 150 feet without reaching the rock. At this average depth water was struck in gravel, and would rise as stated about seven feet above the surface of the ground, and in that way a limited water supply has been secured for the Town of Berlin, with a flow from the wells of about 700,000 imperial gallons per day, which just about supplies the needs of the town at present except in the summer time. I do not know what we will do next summer; probably we will have some more wells by that time. In the Town of Waterloo adjoining they have secured an ample water supply. Of course, as it was a smaller town their needs are not so great, but by putting down three seven-inch pipes about 100 feet in depth they have secured upwards of half a million gallons per day of very good drinking water. This book that I have here shows one of these wells a few minutes after being struck; and that is right in the heart of the town. It illustrates the point that engineers should not begin any extensive water works investigations before they put down a pipe to test whether they have not right in the heart of the town a better water supply than they can get by going miles out.

Mr. MacPherson spoke of the artesian well water that they have got in Galt. At one time it was recommended by the engineer they employed to report upon water supply, to go out to a lake about three miles from the town, which would entail an expenditure of about $10,000, I think, at the lowest calculation, and this was avoided by digging a hole right at hand at a very small cost, comparatively speaking; and they got the water at their pumping station. Engineers in the future will be looking to the best interests of the municipality employing them if they will request them generally to put down an artesian well. Of course, I do not mean where they have the great lakes to draw upon that they should spend money in this

way, but where there is no water supply close at hand you don't know what you might strike 100 or 200 feet below the surface.

Mr. Van Buskirk—I am rather surprised at the President making a statement that this is the first paper on the subject of artesian water. I think I recollect a gentleman, who belongs to the Association, reading a paper after having collected information on the subject, and who has probably more to say on this matter than any of us.

I do not altogether agree with some of the remarks of the President on the question of advice to the municipalities, because there are many places where the artesian water is not by any means as good as the water on the surface, not only for the purpose of domestic use, but especially for the use of railways and manufacturers. The railways will not use artesian waters if they can help it, especially when it comes through limestone. In many towns the revenue from railway companies is a considerable item, which must be considered, and unless we are unable to adopt some other method of supplying water it is very doubtful whether it is always desirable to use artesian water.

The President—I do not always deem it advisable to look for artesian water, only in the event of there being no water supply close at hand. Before going any distance to reach a surface water supply it would pay to make investigations as to the underground waters. Of course, the data might already be at hand through private individuals having sunk wells; and if they have got water so impregnated with mineral that it would not be suitable for water supply, of course there is no further investigation needed.

Mr. Van Buskirk—I do not refer to water impregnated with mineral matters. I refer simply to the hardness of water. The whole denunciation is on account of that; and, although our public may not be very much averse at the outset to a hard water, its objections will soon be made; it has come to that in every other part of the globe, and machinery must be put in for softening the water. Where it is at all possible to get soft water it would be the best thing to get it. I prefer the soft water in all cases; that is my own personal opinion, and I think in future the public will demand it. The business of the artesian water supply is new, and is very attractive, no doubt about that. You can dig a hole at your pumping station and get the water; in many cases it is the only thing to do, but in future I am satisfied

the public will demand something better, and there is no doubt that the bacterial system of filtering water with sand filters will give us a perfectly pure water; and moreover, it is not hard—that is the main point.

The President—Mr. Van Buskirk seems to assume that artesian waters are necessarily hard. Well, of course, they are harder than the rain water, in this province at least. But in Berlin we have secured an artesian water supply which is, on the authority of the Provincial Board of Health extremely low in the scale of hardness. The first requirement of a water supply is to give good drinking water to the people of the town requiring the supply. If they can be given it so soft that it will make good water for boiler purposes, all the better; but it seems to me it is the duty of the manufacturers themselves to soften the water for their own use. We find if you give beautifully clear, pure water for drinking purposes that the townspeople are quite satisfied, and do not care much whether it is going to scale the boilers or not.

We have with us, as a visitor, Dr. Bryce, Secretary of the Provincial Board of Health, and we would be glad to hear from one who has had extensive experience in artesian water supplies.

Dr. Bryce—I thank you, Mr. President, for the opportunity of making a few remarks on this paper. I know of no subject which combines the several arts of the engineer and the Health Officer more than that of the question of artesian wells. It was my fortune years ago to live at the College in Guelph, and I then was responsible for the recommendations which I made as to the sources of water supply for that city, and since that time in my present work I have naturally felt an interest in the subject. I know pretty nearly all the sources of the public water supplies in this province, and the variations in the constituents which are found in the water is one of the most interesting things I know of.

We may divide water into five classes, quite different from the analysis of a standard water which we get in our older chemistry books. We all understand how that is. We have a Laurentian region towards the north giving us a water without a fragment of lime in it. We have got the waters of the upper lakes almost free from lime—I think about one to two degrees of hardness. We come around to Lakes Erie and Ontario, and there is seen a certain amount of lime as we see the water from rivers flowing

over the limestone coming into these lakes. The hardness of water of Lake Ontario is about eight in the scale—wholly different from the upper lakes. Then we have our river waters, some of which are really hard, some really soft, as the Ottawa, flowing from the Laurentian region. And then we come to this class of artesian waters. Both you, Mr. President, and Mr. Van Buskirk are right concerning the difference in hardness in these artesian waters. Mr. Bowman is also quite right in speaking about the relative softness of the artesian water of the Berlin supply. Only last week we made an analysis of this water. After using artesian wells for several years in Goderich they gave them up some time ago and went to the lake, with the result that we have had outbreaks of typhoid fever there, because the sewage of the town happens to run into the Maitland river, which empties into the lake not far from the supply, so that they might better have stuck to the hard water. There is another most interesting thing in connection with waters, namely, the amount of other compounds in them; for instance the amount of organic matter. One could hardly conceive that water down 130 or 140 feet below the sand would have a high amount of organic matter; yet the samples from Aylmer analyzed quite as high as the waters from the bay at Parry Sound, giving 3 parts of free ammonia and 0.24 of albumen ammonia in 1,000,000 parts of water. Of course, it is at present in a different combination, there being no notable nitrates present, reduction having taken place. One wonders how it is that so deep a water should have organic matters so high. The only explanation apparently is that it is on the top of those rocks in which are those organic matters which seem to make coal oil. Certainly such water has no sanitary difference, because it is absolutely pure microbic matter, and thus the effect upon health could not be bad. The other element in such water is the chlorine. We have had some experience in this. About ten years ago the Town of Kincardine required water. The great lake was in front of them there. There were also springs where they could gather emerging water on the clay under the sands near the lake shore. I said to them: "If you take lake water, you will have to filter your water or filter your sewage." In the meantime they discovered that they had an artesian well in the town; and one engineer of an American company went home and reported upon what had been stated by the previous engineer regarding the proposed sources, and informed his people that there was a splendid artesian well to be

had. But No. 1 got back at him by having it analyzed, and found that it had 1,000 grains of common salt to the gallon. The whole explanation was that the boring had been for salt through the upper limestone, in which was abundant water, down to where the salt formation was. They had gone for salt, and they got salt water, but the water did not come from where the salt was. The water came from the underlying rock, about 120 feet, and after boring for salt the water dropped into the boring, dissolved out salt, and came up as an artesian well supplying 1,000 grains to the gallon. The result ended in taking the water from a well on the sandy lake shore, into which sub-surface and lake water both filter.

I could go on relating to you the conditions under which many of these artesian waters occurred. I know fifty cases in the Province of Ontario which are most interesting. I know nothing more interesting, from the uncertainty as to what you are going to get as you bore down. Then, 230 grains of salt per gallon occurred in the Chatham well, but the closeness of the clay seemed somewhat to prevent the water from coming with any great force, and the supply proved insufficient. These wells are lower than the lake, and whenever Lake Sinclair got stormy the influence spread rapidly to those deep waters, and they came up milky in appearance, and there would be a foot or two increase in the head of these artesian wells' supply. I presume the influence—that is, the pressure on the water, caused it to flow up a foot or two, and compression of air in the water caused the milky color.

I asked Prof. Galbraith whether my explanation was correct in regard to the Newmarket artesian wells. The borings go down below the level of Lake Simcoe, and the water in the deep water-bearing sand would naturally flow out into Lake Simcoe. However, the artesian well exists there, and they have taken the public water from there; and the professor agrees with the supposition that the sand, plus the lake pressure, prevents the outflow of water in the water of the lake as readily as the head of water causes it to be lifted up a tube or boring rather than to force itself through the sand. The water comes up through a boring, which is down some 130 or 140 feet.

These are but a few illustrations; and certainly I know of nothing that is more interesting to the geologist, the engineer and the health officer than this whole question of artesian waters. Fortunately in this province we have these artesian wells in every

corner; even as far north as Huntsville, on top of the Laurentian, they have an artesian water supply. I may say in regard to the question of goitre that a great deal has been said in regard to the lime in water for the last thirty or forty years as a cause of it, but I regret to find that no one has yet discovered anything on the subject. We were told years ago that the goitre of the valleys of the Alps was due to the existence of lime in the water. Now it happens that goitre is prevalent in many of the valleys of the granite rocks where there is no lime. So much for the theory of lime in water. I heard also from one of our doctors, who has a large practice in this special work, that the chief number of his goitre patients come from the Laurentian district, a district where there is no lime. Personally, I think that the goitre has more to do with the habits of life in the matter of diet than anything else; and I would say in answer to Mr. Gibson that I am quite certain that the amount of lime that is in our various foods, such as meat products, is probably ample for all our purposes, and that the amount of water that anyone is going to drink from Muskoka is not going to seriously affect the question. As you know, boiling water takes out much of the lime; and after boiling your house water it is, relatively speaking, soft water anyway. I confess that there is not enough of practical importance in this question of lime as the cause of goitre to interest me very much. Personally, I am convinced we had better stick to the waters than any other source of drink supply.

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SOME PUZZLES IN OUR MINING LAWS (Ont.)

By A. J. RUSSELL.

Considering their rigid adherence to straight lines over swamps, lakes and crags, with fly and rain accompaniment in summer, and deep snow with 40 deg. F., below zero in winter, and a beautiful combination of the two in spring, surveyors are the hardest worked and most uncomplaining people on earth, and it should not be considered surprising if, after one third of a century of such experience, an occasional crank like myself is developed, especially, when you add to the foregoing, the mental strain of striving at the interpretation of the "elegant" (as a Yankee legal friend of mine calls them) Mining Claims Clauses of the Mines Act.

I desire to warn my poor struggling brethren of the ordeal they will have to undergo in their endeavors to "catch on" to the Q. E. F.; viz.: a correct delineation on the ground, accompanied by the usual plans, etc., for Lease or Patent—a survey which you can conscientiously accept pay for as being "according to law."

The Regulations for Mining Divisions, approved by Order-in-Council of September 15, 1897, would apparently indicate that the Government, for which the Mining Bureau must assume the responsibility, had hatched—so far as Mining Claims were concerned—a series of Clauses which placed unlimited powers in the hands of the Commissioner of Crown Lands, the Bureau fondly imagined they had evolved an improvement in the Dominion and British Columbia Mining Laws, though I am quite certain, the present Director of Surveys would not endorse such impracticable regulations.

On the 29th January 1898 these regulations were "revised and amended," and finally on the 27th May 1899 they were again polished up by an Order-in-Council, and eventually, after nearly two years of experience and tinkering, we have been given superficially clear and concise "Regulations *re* Staking out Locations in the Unsurveyed Territory of Ontario."

The clauses I desire more especially to draw your attention to are Nos. 6, 7, 8, 9, 10, 14, and 16.

How, in the first instance, the great bulk of explorers and prospectors of limited education and means, and eventually the surveyors, are to manage to comply with those regulations is a conundrum. To begin—the surveyor is not given a starting point, and consequently has to toss up for the choice of position, or act on the advice given in an able paper on "Descriptions," read before this Association by our eminent confrere, Mr. Otto Klotz, where he says: "The law certainly does not constitute the surveyor judge in such matters, but law is supposed to be the incarnation of common sense, and he makes his survey and description accordingly."

Taking the clauses *seriatim:*

Clause 6 requires that corners shall be marked by a post or iron bar; and surveyors, of course, would be delighted to have such a precise point as an iron bar to connect with, but such refinements are conspicuous by their absence, and in some cases not even a post is in evidence. Occasionally a large stump does duty for a post, interfering with the placing of a transit at the corner; and again a tree, and sometimes even several trees, all intended to indicate one common point—very mystifying and provocative of *gores* and *augmentations*. What a field of work is thus being provided for an unscrupulous, I was going to say, surveyor (but that would be a libel on *our* profession), or a less scrupulous brother of the legal fraternity.

Clause 7 states that a location staked out "shall be a square" of so many acres; the older regulations read, "not to exceed" so many acres, which was much more rational, as we know that mathematical exactness being impossible, the saving reservation of "more or less" enters into all such measurements. What do you say to an allowance margin in excess of 30 per cent.? Surely such liberality must have been learned in the same old school that produced a surveyor, who laid out a large timber limit and handed in a beautiful pictorial plan, but unfortunately, when his notes were checked therewith, and his attention drawn to what was deemed a glaring discrepancy, he naively remarked: "See here, if you fellows are going to make such a fuss about a mile or so this matter will never be settled."

A prospector with good, long legs should be in demand for pacing the sides of claims, so long as he acts "on the square," for surely that should be adhered to, as it is much easier to approxi-

mate to a right angle than with one's legs as a pair of dividers to measure, within a reasonable limit, amongst hills and swamps.

Clause 6 also requires that the boundaries shall be laid out east and west and north and south *astronomically*, but the results on the ground are apt to recall the famous arguments respecting the disputed north-western boundary of the Province of Ontario, when they were endeavoring to elucidate the meaning of "northward" from the forks of the Ohio and Mississippi rivers. It was then contended that northward might mean "in a northward direction, but going easterly or westerly"; any line, in fact, having an inclination, be it ever so slight, northerly from east or west; and I presume, in places where local attraction or oblique mental vision prevails, an equally liberal interpretation might be allowed.

Clause 9 refers to a method of indicating the true position of a corner which falls in a lake. It says such a corner "*may be* indicated by planting at the nearest suitable point a witness-post with certain marks thereon," and thus leaves it optional with the locator to plant a witness post or not as he pleases.

The change of the former appropriate name of "Mining Claims" to "Mining Locations," thereby confusing the term with the nomenclature in Clause 28 of the Mines Act in the last Revised Statutes relating to the actual survey by a surveyor of a mining location (in the sense in which it has always been heretofore understood) is in reality a retrograde step, although apparently giving force to the clauses I have criticized. The result apparently is that "any person," on payment of $10 for a miners' license, can practise surveying (?) in the field, whether a British subject or not, quite regardless of the conditions imposed on the members of our Association.

On a first perusal of the regulations the uninitiated might imagine that the Bureau had evolved a perfect set of rules, and when I quoted them for the first time to my professional brethren the usual remark was, "It appears quite simple. It's a perfect square. You commence at No. 1 post; run south (ast.) fifteen chains; thence west (ast.) fifteen chains; thence north (ast.) fifteen chains to the point of commencement." Such exactness we do, indeed, see carried out in the location and survey of mining claims on Dominion lands or in British Columbia. Where No. 1 post is a governing point, and the direction towards No. 2 post as governing the alignment, which may be in any

direction, but our claims have *corners*, which have been *staked* out, and presumably must be perpetuated; in fact, I am officially informed that a surveyor must *join the corner-posts by straight lines*, so that all the "shall be's," and "astronomical," and "fifteen chains," and "square," and "22½ acres," really have no existence except on paper.

Well, gentlemen, not wishing to arouse ill-feeling by arbitrary action, and taking it, of course, for granted that the framers did not know what the outcome might be; hoping also by diplomacy to arrive at a happy solution of some of the puzzles, I wrote, July 28, 1899, asking the Department of Crown Lands how, under certain contingencies, I should proceed to make a survey. The reply was delayed for nearly three months, until 16th October, by which time I had decided to withdraw from that unfortunate division. And a rumor obtains that there were widely divergent opinions amongst those who were consulted in the matter, and who might be held responsible for the consequences as to what form the reply to my letter should take; some one even venturing the opinion that the lines *as blazed* should be followed. This may be law, but I do not think any surveyor would undertake the contract for making such a survey for $100 a mile, even were it at all possible. Here several sketches were shown on the blackboard, exhibiting the errors that come in under the present system.

It is needless to go into details respecting the various surveys that were made, and the multiplicity of combinations developed. The diagrams coupled with the regulations afford, to even an unprofessional critic, ample opportunity for mental gymnastics.

Several rather novel ideas, originating in the Bureau in its attempts to further instruct the explorer when at sea, respecting staking and eventual survey of claims, have come under my notice, but I believe enough has been already exposed to convince this Association that it is time to draw the attention of the Government to the serious consequences which must follow from an adherence to the unfortunately impracticable Acts and Regulations, as they now are and have been for several years past. I have touched on some of the instances which have already caused much trouble and heavy expense, and, if I am rightly informed, the Government is either unable or unwilling to attempt an interpretation of its own Acts.

The British Columbia Regulations, respecting the staking out of claims, result in a heterogeneous-looking collection, when a group of contiguous claims are surveyed, but the discoverer of valuable mineral can, in a very brief time, mark out to the best advantage, and in an indisputable manner, the dimensions of the land he is entitled to. The final precise location of the corners and definite boundary lines is left to the surveyor, the explorer having but three posts and one line to mark, thus avoiding all the entanglements resulting in after years from, as in the present system, having three lines run on each side, viz.; The first, a blazed one, by the explorer; the second, a trial line by the surveyor, and the third, the final line, a blazed one, also by the surveyor.

If the Government are wedded to the present corner and boundary system, it would be well to add an explanatory clause to the effect that reasonable approximation to the alleged ideal was expected, and that the explorer should, for his own sake, as well as in the interests of those who might follow him, run a visible picket line (not blazed) from post to post. This would be a vast improvement on the original non-apparent (blind?) line, and a step in advance of the blazed curves and kinks now to be found. The corners should invariably be large posts, well driven in the ground, and surrounded, where convenient, with a pyramid of stones, which would be in evidence were the post destroyed by fire. The corners should also be tied in to bearing trees, the kind, dimensions, distance and direction being recorded with the local inspector. Where a corner falls in a lake, the witness post should invariably be assumed as being north, south, east or west, as the case may be (ast.), from the actual corner. The prolonging of the land boundary should not be tolerated, as, when that distance is short and the described direction seriously out, an absurd and annoying enlargement of error must follow.

Before closing, I desire, on behalf of the genuine explorer, to press two matters. The first is that when a license is purchased, either from the Crown Lands Department direct or the local inspector, it should be good for its face value as a license in any part of the Province. The next is one deserving of immediate attention. In staking claims, the "one man, one vote" principle is, I trust, the spirit of the law, and the buying of licenses on behalf of "his sisters, his cousins, and his aunts" should be entirely done away with, otherwise the man with many

aliases can lock up a large block of land, to the manifest discouragement and disadvantage of the really poor explorer, of whom, as, indeed, can be sometimes said of more than one surveyor I could mention, $10 occasionally represents the amount which overlies his proverbial "bottom dollar."

DISCUSSION.

Mr. Van Nostrand—This paper is from Mr. A. L. Russell, of Port Arthur. The paper has just arrived, and I have had no time to read it over, previously, but I hope there will be a discussion.

Mr. Speight—I am sure we would all like to hear from our old friend, Mr. Blue.

Mr. Blue—This is the first opportunity I have had of attending the meetings of this Association. I have been reading your reports for years and I do not remember to have come across a paper in all your published proceedings that has struck me as forcibly as this paper has. I know something of the matters which have been criticized by Mr. Russell, and I am not a little surprised at the number of complaints he has made. Why he should speak so much in detail in the discussion of the matter or why he should fail to comprehend what I conceive to be the clear and transparent meaning of the Mining Act, I do not understand. He tells us that he decided there is no starting point in surveying this kind of claims. Just allow me before referring to that, to refer to his criticism of the use of the term "mining locations" in the Act as distinguished from mining claims. a mining claim was held under a license, and the tenure was simply one of holding and working. But many of the claim holders said we want something more permanent than that when we come to dispose of our interest to prospectors, the great majority of whom are simply prospecting in order to discover some valuable deposit of mineral which they may place on the market, not which they themselves may work. Well, we regarded that as reasonable and provision was made under which a mining claim might be surveyed and taken up as a mining location under the provision of the Act relating to mining locations.

Mr. Russell says that there is no starting point in the survey. The regulations of the Act itself are quite distinct. The starting point is the post No. 1, which is the north east corner post of the claim, and in the staking out of a claim the regulations under the Act call for the planting of a post of iron or wood to distinguish it. It is not the fault of the Department if a prospector knows the provisions of the Act, and yet marks his point with a stump or stone or any other article. If he does so he is simply not carrying out the provisions of the Act, and if the inspector should go into his locality he can require him to do so. The regulations of the Act fixed four different marks on a claim, Post No. 1, Post No. 2, Post No. 3, Post No. 4. They are required to be at a certain distance from each other and it is assumed that the lines between them are to be run as astronomical lines. We all know pretty well that prospectors are not able to run astronomical lines with the use of their compass, and that country is rough and rocky with a great many inequalities. We have, therefore, not made any provision in the Act to require the exact measurement or exact lines. But if the complaint is made to the inspector that a claim-holder has not run his lines astronomically or if the boundary lines are in excess of the lengths described in the Act, and if complaint is made to the Inspector, he has simply to call in the services of a surveyor and to run the lines astronomically, and what I say is that the limits as described in the Act start out from one post. It is, therefore, quite incorrect on the part of Mr. Russell, if I understand him aright, to say that there is no starting point in the survey of a location.

I have already referred to his complaint in regard to the excessive area. There is no doubt, I think, in the case of some of the claims there has been an excess of area as staked out; but the Act remedies that matter. It is only necessary to make complaint to the inspector and a correction is made.

I understood him to say again that we had introduced a provision into the Act which gives to a licensee the authority of a land surveyor. There is no provision of that sort in the Act or the regulations. The licensee who takes out the license, for which he pays $10, has the privilege of staking out his claim; but that does not constitute him a licensed surveyor, and his lines would not be recognized as the lines of a licensed surveyor.

The special case that Mr. Russell has used for his illustration involves some difficulties; but in my judgment they are difficulties which to a large extent have been created by Mr. Russell himself. Mr. Russell appears to think that the Government have had some difficulty in understanding the Act and the regulations themselves. I know that this is not the case. A memorandum was submitted to the Government. It was considered by the Attorney-General's Department, and it was agreed to; and these surveys will be carried out in accordance with the interpretation put upon it by the department, which, I think, is a clear and common-sense interpretation. I do not see myself where the great difficulties come in that trouble Mr. Russell; perhaps they would be obvious to you who are practical surveyors. I should be glad to hear what you have to say on the subject.

Mr. Kirkpatrick—Well, I have not very much to say, because I have not entered into this question before. But Mr. Blue says that it is now before the Department. You will notice that in the Rules and Regulations it is provided that the parties shall blaze out the lines. Well, I have heard from different surveyors how this is done: that they do not pretend to range a line at all, but that they look ahead, and they walk around, and they blaze a tree here and there; and in one case, when a man got to the corner, he rolled down an embankment about 100 feet, and he put his mark there because he did not want to climb up again! The consequence was the blazing was here and the post there. I would suggest that the line be picketed, and not blazed. The man after taking his compass and getting his course, should put in a picket; it is not a very great distance to run in any case, and if he just cut out some of the brush that was in the way and picketed these lines so that anybody could see them, they would remain visible for a year or two, or perhaps longer, until he could get his claim surveyed.

Mr. Blue—At what distance are the pickets?

Mr. Kirkpatrick—Oh, the distances vary. If they are going to run over a hill, they have either to use very long pickets to get over, or they have to use a large number of pickets. Running on a level, I think that five chains is about what surveyors have between pickets. The lines should be picketed out and the posts planted.

I do not exactly understand Mr. Blue's remarks about turning

a mining claim into a location. As I understand it, they call them mining claims always.

Mr. Blue—They are not mining claims; they are called mining locations.

Mr. Kirkpatrick—I do not understand that.

Mr. Blue—My understanding is that when surveyed they are mining locations.

Mr. Kirkpatrick—I do not think that that amounts to a row of beans.

Mr. Blue—This has been the custom for years.

Mr. Kirkpatrick—A mining location is defined in the Mines Act as being an area of 40 to 320 acres.

Mr. Blue—A mining claim is there defined also.

Mr. Kirkpatrick—Not in that clause. That is where I think Mr. Russell's difficulty has arisen. If the Mining Act had specified that a mining claim on being surveyed should be declared to be a mining location, it would be a mining location; there is no gainsaying that. There is nothing else I can say on this matter. I am not prepared to criticize what Mr. Russell has said.

Mr. Speight—I can quite understand the difficulty that the prospector would have in blazing out a line and coming within the limits of the Act as far as the distance specified is concerned. It is an exceedingly rough country; many of the hills there are very high. I happened to meet Mr. Russell up in that country. I was running some lines for the Government, and he was then surveying there.

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AZIMUTH AND TIME BY OBSERVATION ON POLARIS.

By CYRUS CARROLL.

The paper by Mr. Stewart published in the Proceedings for 1890 is certainly a very useful one, as it gives formulae for reduction of observations.

I, for one, shall not attempt to follow out the brain twisting calculus by which he obtained such admirable results,—life is too short, and besides, I don't know whether I could do it or not. I am content to take his formulae for granted—the same as I do our tables of Logarithms and in fact all our Mathematical tables, though not entirely ignorant of the means by which they were made.

I am speaking, of course, for myself only, but I think most surveyors have openly or secretly the same mind about these things. I have said that it is most useful, but that depends. For topographical or for astronomical work in an observatory, with all required assistance, with instruments in perfect order (probably not much used), it is necessary to be so exact that the error will be too small a quantity, to be assignable, will in fact be exhausted.

But for timber limits, mining locations, subdivision of Townships, subdivisions of sections or lots, an approximation as near as 20″ to the true direction is as near as it is of any use to make it, being only six inches in a mile, which unless the line be run with two pickermen, back targets, setting two or three points forward, at a quarter mile apart, testing to see if all is in line, and then on moving forward, test the last few points backwards, aligning on the target, using tacks and shingle nails as points,—I say unless the line be so run the deviations from a

Now $OP = \sqrt{SP^2 - SO^2} = \sqrt{4417^2 - 1596^2} = 4118$

$$AZ = \frac{\text{Rad.} \times OP}{\text{Cos. Lat.}} = \frac{\text{Rad.} \times 4118}{\text{Cos. } 43^\circ\ 39'\ 36''}.$$

Log. Rad. =	10.000000
" 4118 =	3.614686
	13.614686
Log. Cos. 43° 39′ 36″ =	9.859408
Log. AZ =	3.755278

$\therefore AZ = 5692'' = 1^\circ\ 34'\ 52''$

Nat. sin $WPS = \frac{OS}{SP} = \frac{1596}{4417} = 0.36126$, $\therefore$ Arc $WS = 21^\circ\ 10'\ 40''$

21° 10′ 40″, in Sid. time =	1h. 24′ 42″; in Solar time = 1h. 24′ 39″
Add. Solar time at W =	18h. 52′ 42″
Time of Observation =	20h. 17′ 21″

Comparing Azimuth — Mine =	1° 34′ 52″
Mr. Stewart's =	1° 34′ 47″
Difference only	0° 0′ 5″

Place of Observation west of Standard, in Sid. time =	0h. 17′ 35″
in Solar time =	0h. 17′ 34″
Add my time as found =	20h. 17′ 21″
Standard time =	20h. 34′ 55″

Hence it appears, that if I had used his watch, I would have arrived at the same result practically, as the 12″ error in the watch would have made no material error in the azimuth.

I find that if I take the observation at 2h. 45′ after elongation and make an error of 1′ in altitude, it will vitiate the azimuth 1′ 15″ and 2 minutes in time. Hence an error of 1′ in time would make an error of a little over 30″ in azimuth at that point.

An error of 1′ in time or in altitude will have but very little effect at 1h. from elongation and not too much at 2 to 2½ hours.

This leaves an interval of 5 hours in which this sort of observation may be approximately made. I have never yet had to wait long. It pays to have a good reliable watch, well regulated, and to make a note of its rate, and a quadrant or sextant, a big one (not the little round pocket toys) with which to take altitudes properly.

with hours numbered from midnight to midnight and calculated for 4h. 46′ W. For the purposes of explanation, I refer to figure 1 which is the circle of apparition. The upper transit of the star at U = 12h. 53′ 45″ (per Canadian Almanac).

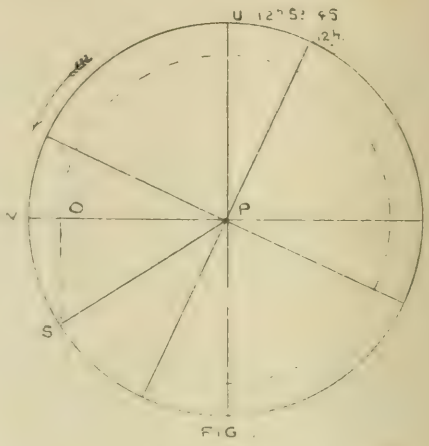

FIG.

W its west elongation, S is the star, P the pole, SO a perpendicular let fall from S on WP meeting it at O.

SO=Latitude — Altitude.

SP=Polar Dist. (per Almanac).

For the purposes of azimuth the triangle S.P.O. may be treated as a plane triangle, with its sides expressed in seconds as units of linear measurement.

With the given parts SP and SO, I find the angle SPW, the measure of the arc WS which is the time after the elongation.

And with the same SP and SO, I find OP which I treat as if it were the Polar distance and as if the dotted circle were the path of apparition. I use his longitude for the 4″ correction in the time of the upper transit and to bring my time to the standard time that Mr. Stewart uses.

Here is the preparatory arrangement of the data.

Time of upper transit (Can. Almanac)			12h	53′	45″
Correction for 4h 46′ to 5h 17′ 35″					4″
Solar time of upper transit			12h	53′	41″
Arc U.W. = in sid. time 6h 00′ 00″					
In Solar time			5	59′	1″
Solar time of West elongation			18h	52′	42″
The Latitude	=	43° 39′ 36″			
— Altitude	=	43 13 00			
OP	=	26 36	=		1596
Polar Dist. per Almanac = *SP*	=	1° 13′ 37″	=		4417

straight line will be more than 20″ or 30″ of azimuth would cover.

Students fresh from college, who "know it all," will ridicule this, but old surveyors like myself will know it is true. The one year's apprenticeship is not sufficient to enable any one to understand and handle a transit with all the nicety required, more especially if his practice is in the usual way of setting the instrument up over a hole in the ground, and sighting to a big unshapely picket, shaking in the wind and its upper end not always staying where it was put by sighting from the instrument. Then again, he may not go out once in a week.

An instrument 1,000 miles from the maker, in constant use, not to say abuse, for months, in a range of 150° of temperature, will inevitably get somewhat shaky, and in such condition must be used.

I use the tangent screw only in turning off the azimuth. This is good in any case, but especially so with shaky tripod.

I always use "Polaris" when I can. In fact, it has always been *The Sun* or Polaris with me.

It is quoted of Delambre, that he had much experience, and that he deprecated the use of two stars, claiming that he had better results from one.

I prefer to take the observation in twilight, when I can just see the star and the wires, without any artificial illumination.

I place the transit in good daylight, plates at zero and clamped, select my reference object, if possible so near the line of the star that in moving from it to the star I need only to use the upper tangent screw. Then I elevate the telescope to the latitude which brings the star in the field, then clamp the vertical circle, and with one hand on its tangent screw, and the other on the plate tangent screw, I bring the intersection of the wires on the star, and note the time. Then I drop an oiled silk cap lightly over the instrument, so as not to distend it, and leave it till morning, but as a precaution against possible movement of the instrument I take the readings.

I now take up Prof. Stewart's observation, using his data but adding the observation for altitude which must be had for my purpose when I don't use the time. I don't make use of the time because he did not. I use the Canadian Almanac

The latitude is a vital requisite as well as the altitude. The latitude is generally to be got at within convenient limits, by dead reckoning, *i.e.*, by course and distance from some point where it is known, or the sun can be used to get it, or by any star of which we have the declination.

If we are nearly in time for the transit of "Polaris" across the meridian, we may use that, if not, then we shall be near the elongation probably, and if we use elongation, the latitude need not be got so exactly.

In the first hour before and after elongation, if we have the time within 5 minutes, it will be sufficient.

The writer is aware that this solution of Mr. Stewart's example, is not absolutely and mathematically correct, but it is nearly so for azimuth—not 6 seconds out, which is near enough for 96 per cent. of the work of 90 per cent. of the *profession*, that is if used within, say, 2½ hrs. of elongation. I would not use it in getting the time, as there are easier and more accurate ways of doing that.

As I cannot be present, I would ask that kind consideration be given to that fact. I would not be understood as undervaluing Mr. Stewart's formulae. I am glad to have them and shall use them when on the finest kind of work, but I think for practice such as most surveyors have, my method is preferable as being shorter and more simple.

Its very simplicity will be a fatal objection to it, with some surveyors, but it ought not to be.

DISCUSSION.

Mr. Ross—This interesting paper by Mr. Carroll is before you, and I think we would like to have some remarks from Mr. L. B. Stewart.

Mr. L. B. Stewart—On looking over Mr. Carroll's method, at first I was a little inclined to regard it as a rough one, but I saw there was a possibility of arriving at a method of finding the azimuth from the data he used, so I have kept a few of the results I worked out some days ago. By his method he works out an example, and gets the same result as I do within five seconds. I took the same example, and worked out the altitude of the star at the time of observation, and figured out the azimuth from that, using an extension of his formula, and I found its value to be equal to 5707".3 minus 20".7, the difference

being 5686.6. This result agrees with the azimuth obtained in my example last year within a few tenths of a second; in fact, I call it 5687, so there is a practical agreement. Mr. Carroll gets the same result within five seconds. But the value of the altitude he uses is 43 degrees 13 minutes, and the value of the altitude which I worked out from the example contained also 27 seconds, and I think that is where the difference comes in. I consider the method a very good one if used in this form; using the simpler form of the equation, it might be in error to the extent of twenty-one seconds. Of course, for a great many purposes that would not be very important. It is evident on the face of it that the method cannot be used when the star is very far from elongation. If the star is near the meridian a small error in the altitude will have a very considerable effect on the resulting azimuth.

Mr. Ross—I think we are doubly indebted to Mr. L. B. Stewart for the explanation he has given and the formulae he has worked out.

Mr. Niven—I think we are very much indebted to Mr. Carroll for writing the paper, and to Mr. L. B. Stewart for the explanation he has given us. Of course, it would be a very nice thing to have this worked out so that people could get an observation at any time. But up to the present time I must say that I have confined myself to elongation, preferring to put up with a little inconvenience and do something I am certain about rather than risk the other.

I move that the paper be received and printed. I would also move a vote of thanks to Mr. L. B. Stewart.

Mr. Speight—I have great pleasure in seconding that. I am glad to see that there is so much in the paper to commend itself. Apparently Mr. L. B. Stewart has checked the formula that is given by Mr. Carroll with great care, and we must all say with satisfactory results.

Mr. L. B. Stewart—Mr. Chairman, I think this method of Mr. Carroll's is a very useful one, as it gives the surveyor much greater latitude in which to work, a much greater length of time during which he can observe for azimuth; and, I think, even one hour after elongation, that by his method azimuth can be determined, and should not be more than half a minute astray.

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AZIMUTH BY POLARIS.

By OTTO J. KLOTZ.

Ottawa.

The accuracy of the direction of lines of survey is becoming more and more important with the development and progress of our country. As many of our surveyors are engaged in laying out new lands, establishing the astronomic courses of old compass lines, laying out mining claims and other work requiring the determination of the true meridian, it is thought that a few words on the azimuth observations on Polaris might be opportune.

I think that, generally, an observation for azimuth is looked upon by surveyors as more or less of an undertaking. This should not be the case. Theoretically, the best time for taking an observation on Polaris is at elongation, for the element, time, has then its least effect. However, as the time of elongation (eastern) comes only at a convenient time from the middle of August onward to the latter part of October, i.e., the time varies from 10 p.m. to 5 p.m., the earlier summer months necessitate sitting up or getting up at night at inconvenient hours, for making observations, besides running the chances of a cloudy sky. If, on the other hand, the surveyor adopts the method of observing at any hour-angle, which too is a simple operation, he will be able to choose his own time and convenience, with satisfactory results.

In connection with observations at elongation, it may not be amiss to examine the effect in azimuth of small changes in latitude and declination in the data used.

In the spherical right-angled triangle we have

$$\text{Sin } A = \text{Cos } \delta \text{ sec } \phi$$

where A = azimuth, δ = declination, and ϕ = latitude.

Differentiating we get

$$\text{Cos } A \, dA = \text{Cos } \delta \text{ Sec}^2 \phi \text{ Sin } \phi \, d\phi \qquad (\delta \text{ considered constant})$$

$$\text{or } dA = \tan A \tan \phi \, d\phi$$

by which we can find the change of azimuth for small changes in latitude.

Taking for Polaris $\delta = 88° 46' 26''.72$ (mean place for 1900) and $d\phi$ the small change in latitude as 1′ or 60″, the corresponding change in azimuth dA is shown for various latitudes (covering the field work in Canada) in the following table:

LATITUDE	AZIMUTH	DA	LATITUDE	AZIMUTH	DA
42°	1°38′59″.02	1″.56	54°	2°05′09″.41	3″.01
43°	1°40′34″.80	1″.64	55°	2°08′15″.52	3″.20
44°	1°42′15″.62	1″.72	56°	2°11′33″.55	3″.41
45°	1°44′01″.80	1″.82	57°	2°15′04″.59	3″.63
46°	1°45′53″.68	1″.91	58°	2°18′49″.84	3″.88
47°	1°47′51″.67	2″.02	59°	2°22′50″.66	4″.15
48°	1°49′56″.16	2″.13	60°	2°27′08″.58	4″.45
49°	1°52′07″.64	2″.25	61°	2°31′45″.38	4″.78
50°	1°54′26″.59	2″.38	62°	2°36′43″.06	5″.15
51°	1°56′53″.59	2″.52	63°	2°42′03″.95	5″.56
52°	1°59′29″.25	2″.67	64°	2°47′50″.68	6″.01
53°	2°02′14″.27	2″.83	65°	2°54′06″.38	6″.52

The effect in azimuth increases rapidly with the higher latitudes as is evident, too, from the above formula $\text{Sin } A = \text{Cos } \delta \text{ Sec } \phi$ The figures given in the last column correspond to those given in the Canadian Almanac as "Second correction."

It may be well to explain that all azimuth tables of Polaris for elongation, even when expressed to individual seconds, are in a measure inaccurate, inasmuch as a constant declination is used for the year, which of course, is not correct. The difference in the mean and apparent declinations is sufficiently large —about three quarters of a minute—to cause a difference in azimuth of over a minute. Hence, one must not imagine to obtain correct azimuths from such tables to within a few seconds without considering the proper conditions. Any such tables are undoubtedly correct for the assumed data, but we must make sure that those data obtain for the time and place of observation.

Observations, otherwise careful, have come under my notice, where this consideration was neglected, and results were given to fractional parts of a second in azimuth, when, in reality, the azimuth accurately deduced, shows an error of a "handful of seconds," so to speak.

Taking our formula Sin A =Cos δ Sec. ϕ, and again differentiating with respect to A and δ, for finding the relation between small changes in azimuth resulting from small changes in declination, we have

$$\text{Cos } A \, dA = - \text{Sin } \delta \, d\delta \text{ Sec. } \phi.$$
$$\text{As Sin } t = \text{Cos } A \text{ Cosec. } \delta$$
t being the hour angle at elongation
$$\text{hence } dA = - \text{Sec. } \phi \text{ Cosec. } t \, d\delta.$$

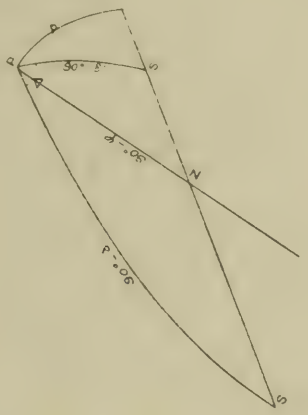
By the negative sign we see the azimuth decreases as the declination increases, or, which is the same thing, the azimuth changes with the same sign as the polar distance. As t is within the wide range of latitude in the accompanying tables nearly 90°, that is Cosec t=1 (approx), hence we may write dA = — Sec ϕ d δ. t is equal to the complement of the azimuth plus the spherical excess, which is small. Since Sec. ϕ is always greater than unity, the change in azimuth is always greater than the corresponding small change in declination and increases rapidly for high latitutes.

From the general formula it is seen that the azimuth is always greater than the polar distance, except at the equator, where the two are equal. In the higher latitudes the azimuth increases rapidly until the limit of 90° is reached in latitude 90° — δ where Polaris is at elongation (eastern and western) at upper transit, and the hour angle is zero.

The following table shows the change of azimuth due to 1″ change in declination, using same data as in previous table.

LATITUDE.	d A	LATITUDE.	d A
42°	1″.35	54°	1″.70
43°	1″.37	55°	1″.74
44°	1″.39	56°	1″.79
45°	1″.41	57°	1″.84
46°	1″.44	58°	1″.89
47°	1″.47	59°	1″.94
48°	1″.49	60°	2″.00
49°	1″.52	61°	2″.06
50°	1″.56	62°	2″.13
51°	1″.59	63°	2″.20
52°	1″.62	64°	2″.28
53°	1″.66	65°	2″.37

We will now consider the observation of Polaris at any hour angle, together with a time star in the same vertical, noting the times of transit of the two stars.



In devising methods and formulae we must never lose sight of the end aimed at, or rather the accuracy desired. For instance, it would be misapplied energy to obtain a latitude to within a second of arc on an exploratory survey, and hence the method of the former would not be desirable for the latter. Use a foot rule for measuring a board and a micrometer apparatus for a base line. With a minute-reading instrument don't give and don't expect results correct to seconds. Mathematical formulae and tables can't produce a closer result than the observation itself. Let there be no delusion with illusory small quantities and decimals. As Professor A. W. Wright in his admirable work "Adjustment of Observations" says: "In a word, we cannot measure what we cannot see." This is in contrast with the illusory statement of Professor Merriman in his recent work "Elements of Precise Surveying and Geodesy": "A good transit, having two verniers reading to half minutes, can easily measure horizontal angles with a probable error of one second if proper precautions be taken to eliminate systematic and accidental errors."

Surveyors, as others, want to travel along the line of least resistance, whether through brule and swamp, or in taking observations and computing them. The more formulae for the field confine themselves to the elementary and fundamental ones, the more they will be used, and for obvious reasons.

Referring to the figure: P represents the pole, S' and S Polaris and time star respectively, and Z the zenith.

Between Polaris and a time star (as between any other two stars) at any instant, there is a constant angle equal to the difference of their right ascension. Were it possible to make an instantaneous observation of both Polaris and the time star, then in the figure the angle SPS' would be equal to $a—a'$, where a, a' are the right ascensions. However, as an interval elapses between observing the two stars on the same vertical, the constant angle is diminished by this interval, expressed in sidereal time, that is

$$(a—a') — (\tau—\tau') = \Delta = S\,P\,S'$$

where τ and τ' are the observed times of transit over the vertical. Now in the triangle SPS' we have PS, PS' the polar distance of the two stars, *i.e.*, the complement of the respective declinations, $90° - \delta$, $90° - \delta'$ and the included angle Δ. Hence, by Napier's analogies, and the logarithmic tables we readily find the parallactic angle. S

Then, in the triangle SPZ we have PZ the complement of the latitude $= 90° — \phi$, PS and the angle S, hence, by the simple sine formula, the angle PZS is obtained, which is the supplement of the desired azimuth of Polaris, or $= \pi — A$.

This method, which does away with the use of the hour angle of the time star, is rigorous, simple, expeditious and accurate, provided the logarithmic functions are accurately obtained or taken out. It may be stated that if logarithmic tables of the trigonometric functions comparable with the vernier reading of the instrument, be used, the result obtained will be in keeping with the attainments of the instrument.

The Napier's analogies required, and expressed in the notations of the above figures are

$$\tan \tfrac{1}{2}(S' - S) = \frac{\operatorname{Cos} \tfrac{1}{2}(\delta' - \delta)}{\operatorname{Sin} \tfrac{1}{2}(\delta' + \delta)} \operatorname{Cot} \tfrac{1}{2}\Delta$$

$$\tan \tfrac{1}{2}(S' + S) = \frac{\operatorname{Sin} \tfrac{1}{2}(\delta' - \delta)}{\operatorname{Cos} \tfrac{1}{2}(\delta' + \delta)} \operatorname{Cot} \tfrac{1}{2}\Delta$$

and the sine formula $\operatorname{Sin} A'' = \operatorname{Sin} S \operatorname{Cos} \delta \operatorname{Sec.} \phi$

In the Manual of Dominion Lands another method is given. It depends on the value of the arc, p, from the pole perpendicular to the vertical on which the two stars were observed.

The two formulae there given, are

$$A = p \text{ Sec } \phi \qquad (1)$$

$$\text{and } A = \frac{\tan P \text{ Sec. } \phi \text{ Sin } t}{1 - \tan P \tan \phi \text{ Cos } t} \qquad (2)$$

in which P is the polar distance of Polaris, and t its hour angle at time of observation.

In the Manual (table xv) the values of p have been tabulated for $\delta = 88^\circ\ 41'$ and for 10 minute intervals of Δ, and 5° intervals of declinations of time star. For any other value of δ p must be multiplied by tan. $88^\circ\ 41'$ into tan. of the polar distance of Polaris, given in the Ephemeris.

The table has been computed from the formula

$$p = P \text{ Sin } \Delta + \frac{P^2}{2} \text{Sin } 2\ \Delta \tan \delta$$

Now if we substitute this value of p in (1) we have

$$A = P \text{ Sin } \Delta \text{ Sec } \phi + P^2 \text{ Sin } \Delta \text{ Cos } \Delta \tan \delta \text{ Sec } \phi \text{ Sin } 1''$$

identical with the equation deduced by Mr. Stewart and applied for reducing his observation given in last year's proceedings.

Equation(2) necessitates the determination of the hour angle of Polaris, before the azimuth can be found. This is a wholly unnecessary procedure, for the quantity sought is azimuth and not time.

We therefore revert to our simple, rigorous formula for obtaining the azimuth by observing Polaris on the same vertical with a rapidly moving, or time, star.

To avoid errors of time of transits, the line of collimation should be well adjusted and the horizontality of the axis assured. The mean azimuth of a line determined from two observations on Polaris, one circle east, the other circle west, will be practically free from the collimation error but not of level corrections if axis is not horizontal. In a well-adjusted surveyor's instrument, the residual error of the latter is a negligible quantity.

As α, α', Δ are expressed in sidereal time, so must $\tau - \tau'$ be. The time of observation is always so selected that the interval $\tau - \tau'$ is, say about five minutes. Hence when an ordinary watch—mean time—is used the correction will be only about a second *i.e.*, at the rate of 10 seconds an hour. The correction has to be added to the interval.

Surveyors observing by this method for the first time will undoubtedly meet with some difficulty, *e.g.*, setting for Polaris, to have it in the field, estimating the time they have to wait until the time star transits over the vertical of Polaris after having set the telescope at the altitude (meridian $=\phi-\delta$). However, one or two observations added to gumption will overcome all this, and observing will become a pleasure instead of a dread which it now so commonly is.

The other formula

$$A = P \operatorname{Sec} \phi = P \operatorname{Sin} \Delta \operatorname{Sec} \phi - P^2 \operatorname{Sin} \Delta \operatorname{Cos} \Delta \tan \delta \operatorname{Sec} \phi \operatorname{Sin} 1''$$

in which P is expressed in seconds of arc, requires a few less logarithms to turn up and is in so far preferable. Although of an approximate form, being the first two terms of a series, it is yet more accurate than results can be looked for from the vernier reading of any surveyor's instrument, and hence furnishes a method to which surveyors can apply with advantage. In working out the above formula it is not as formidable as it appears, for the quantities in the first term are repeated in the second, and hence need not again be taken out.

The main object of this paper is to assist surveyors in overcoming the prejudice or aversion they have to observing Polaris at any other time than elongation. The adoption of observing Polaris at any hour angle, together with a time-star in the same vertical, will add much to their personal comfort and to the greater accuracy of their work, from the fact that more observations will be taken.

DISCUSSION.

Mr. Niven—I do not know that I have much to say. No doubt it is a very good paper. From what Mr. L. B. Stewart, Mr. Klotz and Mr. Carroll have written we ought to be able to make our observations. As I said last night, I have hitherto confined myself to elongation, but it would be a very great benefit, in the way of comfort, to be able to take the observation shortly after sundown. In this paper Mr. Klotz brings everything down to fine points—seconds. Well, that is all right, but it would be very important also that the surveyor should do his practical work with as much accuracy as Mr. Klotz calculates

his azimuth. Many of our profession, I am afraid, do not observe as much accuracy in carrying out their work as they should. For instance, Mr. Carroll said in his paper: "A man sets up an instrument plumb over a hole in the ground, and there is no certainty as to whether that hole in the ground is directly under the instrument. There is a great deal in carrying out the observation on the ground, and very much depends upon that; and we should be prepared to give more attention to this matter than we are in the habit of doing.

Mr. Speight—I have no doubt that when this paper is in print we will be able to take it in better, and apply it in our practice. As Mr. Niven has said, there is no doubt by exercising great care in the work on the ground frequent observations are probably not so necessary.

Mr. P. S. Gibson—How often do you make your observations in a township?

Mr. Speight—I take them two or three times a week if the conditions are favorable. I have always one instrument in camp. I have taken observations probably three or four times a week. I have gone two weeks without an observation.

Mr. L. B. Stewart—Mr. Chairman, after all the papers that have been read on the subject of azimuth, it seems to me that the surveyor who waits up until two o'clock in the morning in order to observe azimuth at elongation almost deserves to have it cloud over at a quarter to two.

In looking over the different methods that have been discussed, it seems to me that the best method is by observing two stars, observing some star on the vertical circle of polaris. In discussing the effect of errors of observation, it seems to me that those errors have less effect on the azimuth in that method than in any other, with the exception, possibly, of the observation of polaris at elongation. As I pointed out last night, the effect of an error in either the latitude or in the observed time in the method of observing two stars is divided by about forty; that is, the error in azimuth is about a fortieth the error in either latitude or the time observed; and I think that is all you can say for any other method that I know of. In observing the altitude of polaris for azimuth, say at elongation, the effect of an error in latitude is practically zero; and also the effect of an error in altitude is also about zero; but if the star is far from elongation, the error in either of the data may be multiplied by a very large

number. The ratio of forty, which the error in data bears to the error in azimuth, is about the maximum value of that quantity; it may be very much less.

The observation of two stars also is an extremely easy one. The method I follow in taking the observation is to choose some star that transits, say, about dusk, or shortly after sundown. It is then light enough to see a picket on the line whose azimuth you wish to determine, or to set a picket; and when I want to find the pole star I generally find the meridian approximately by means of a compass, and then raise the telescope to an altitude equal to the known latitude, and then find the pole star. A few minutes before the time of transit I set on polaris, and turning over the telescope observe the transit of the time star, which should be one of small declination, and when it crosses the field of view I note the time by my watch when it appears on the intersection of the cross wires. Then the difference of those two times with the difference of right ascension gives the quantity delta that Mr. Klotz uses in his paper. In order to pick out a star that is a time-star that will serve for observation, its approximate right ascension can be found in this way: The right ascension of the sun increases about two hours a month and about four minutes a day; so that knowing the number of months and days that have elapsed since March 21st, you can easily compute approximately the sun's right ascension. If you wish to observe at eight o'clock in the evening, a star suitable for observation is chosen from the almanac whose right ascension is nearly equal to eight hours plus the sun's approximate right ascension.

I am more in favor of a formula in the shape of a series. The series given by Mr. Klotz is identical with the one given by me last year, and two terms of that series are sufficient for all purposes; and the computation of the azimuth from that, I am sure, is a very simple matter.

Mr Van Buskirk —I would like to know if any gentleman has practised taking the observation of the sun in the day time. It is done in the States and in British Columbia on mining claims.

Mr. L. B. Stewart—I used that method myself in practice when I was up north; but the observation is a little more difficult probably than with a star. The instrument that I took out had an arrangement of colored shades in the shape of a little wheel that screwed on in front of the eye-piece; so that a

shade of any desired degree of density could be used. Well, unfortunately this affair projected out so far that the telescope would not transit, and it was almost impossible to get an observation, because it meant unscrewing the shades, and that would generally shake the instrument too much for accurate work. So I used to observe stars in the same way as the sun. In the latitude of 64 or 65 the pole star is almost too high for observation. The method I used was: I carried with me, copied from the almanac, the apparent places of about six or eight stars. I picked them out in such a way that I always had a star for observation at any time during the summer about dusk, and I would have also one or two other stars that would serve for latitude observations. Most of the time I found the star Arcturus to serve very well for azimuth, and the star Altair to get my latitude. In reducing, the method is precisely the same as in the case of the sun.

The President—I would like to ask Mr. L. B. Stewart whether the solar compass is still in use by surveyors.

Mr. L. B. Stewart—I have not seen it used much. There are a few, I believe, who use it; but personally I have not a very high opinion of the solar compass. I would far sooner depend upon an observation for azimuth than use a solar compass. One of our transits has a solar attachment, and I find the azimuth with it on a line whose azimuth I have already determined, just in order to form an idea of the accuracy of the instrument, and sometimes it gives very fair results, and at other times it is as much as ten or fifteen minutes astray. Prof. J. B. Johnson, in his work on "Surveying," discusses the solar compass, and he shows that very large errors may result if observations be taken at any but favorable times. The sun should not be too far from the prime vertical. Prof. Baker, in his work on "Engineering Instruments," says that it is an instrument that reflects more credit on the inventor than on the modern user.

Mr. Ross—Although it is probably true that a great many of our members do not find it necessary to take azimuth observations very often, I think the time is coming, and probably very soon, when all registered plans and descriptions will have to show the true astronomical course, and these papers will enable each of us to fix on some method that we may practise and familiarize ourselves with, and which will be of great value to us in the future.

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CEMENT CONCRETE CULVERTS.

By A. W. CAMPBELL.

The subject which, in response to the invitation of the council, I have chosen to place before you to-day, is very much akin to that of last year. This was not overlooked in making my selection. The matter is one which deserves very full treatment for various reasons; and is a detail of road construction regarding which, more than any other, perhaps, I receive inquiry from members of our profession. While there is no dearth of literature and data with regard to culverts of stone and brick masonry, that available respecting cement-concrete arches is very meagre.

The material can hardly be called a new one, for there are viaducts and pavements still in existence which were built by the Romans 2,000 years ago. Its manufacture, however, had, until about thirty years ago, been numbered among the lost arts. It is of a still more recent period that it has been commonly employed, particularly in Canada.

There is a very general impression among councillors with whom you have to deal that it is too expensive. Councils nevertheless, are outgrowing that idea, and in one part of the Province and another, I find waterways of six to eight feet span built of stone, brick and concrete, at a cost of from $500 to $1,000. The old wooden structures, which they replaced, may have cost in the first instance only $50, but they were perishable, constantly in need of repairs, an impediment to travel, at times dangerous, and the trend of feeling is towards more permanent and serviceable work.

The limit of span in which concrete can be used is probably quite equal to that of stone arches. This will remain, for the most part, a question of economy in highway work, and its use will cease where the steel bridge with concrete abutments steps in. The line is not definitely drawn for all cases, but up to forty feet, the least expensive kind of cement-concrete can be used in arches, and certainly up to that point its use

is quite feasible. For the longer spans, arches of the Milan type are being used in the United States and Europe—that is, concrete re-enforced with a skeleton of steel.

Arches of concrete may be designed by the formulae used in proportioning arches of stone masonry. But the determination of the line of resistance, and theory of the arch, as applied to stone, cannot be applied to concrete arches. The stone arch is designed on the principle that it will remain in place without the use of mortar; while the concrete arch, on the other hand, is a monolith, dependent upon its cohesive strength.

That the arch is dependent upon cohesive strength, points, it appears to me, to the necessity of a generous proportion of cement, very great care in mixing the concrete, and the best quality of all materials employed.

My meaning with regard to the proportion of cement can be better understood by glancing over the composition of concrete. A concrete can best be regarded as a mixture of mortar and broken stone, the mortar being formed from a mixture of sand and cement. Given a sample of broken stone in a vessel, the requisite quantity of mortar can be gauged by pouring water into the vessel until the stone is submerged. The quantity of water used will indicate the amount of mortar required to completely fill the voids in the stone. The proportionate amount of cement needed to fill the voids in the sand, can be gauged in the same way. The proportions of cement, sand and broken stone obtained in this manner would provide, with perfect mixing, a mortar of which the voids in the sand are filled with cement, and each particle of sand coated with cement; it would provide a concrete in which the interstices of the stone are filled with this mortar, and each stone coated with mortar. This would be the case with perfect mixing, and would provide a theoretically perfect concrete. Perfect mixing is not possible, however, and it is necessary to provide an amount of cement in excess of the voids in the sand, and an amount of mortar in excess of the voids in the stone.

With proper mixing and good materials, a satisfactory concrete for bridge abutments can be framed from cement and broken stone, in the proportion of one, three and four. But it is recognized that the greatest strength in concrete can be obtained by making the mortar rich in cement, rather than

lessening the quantity of stone. Nor beyond providing for a strong adhesion of mortar and stone, is there wisdom in making the mortar materially stronger than the stone. This applies to crushing strength, however, rather more than to the tensile strength required to some extent in the arch. For the arch proper, it will be well to use a rich concrete, in say the proportions of one of cement, two of sand, and three of broken stone. With small arches there will be little economy in changing the proportions for the abutments.

The cost of the abutments may be lessened, where they are of sufficient thickness, by the use of rubble concrete. The timber casing, or curbing, must, of course, be built up as the laying of the arch proceeds. Within the casing, and firmly tamped against it, there should be placed fine concrete to a thickness of about six inches. This will form a shell for the abutment, inside of which large stones may be placed in rock-and-pinion order, ends up. There should be a space of at least two inches between the stones, filled with fine concrete, and all firmly rammed. The outer shell of fine concrete should always be kept built up six inches or so in advance of the rubble work. This should be laid in layers, and each layer well flushed with a layer of fine concrete. The lumber used in making the curbing or casing, should be dressed, tightly fitted and firmly braced, so that the concrete may be well rammed into place. The exterior of the culvert when finished, should have a smooth face, free from holes; and a surface coating, which is of little use, should not be necessary. The arch centre should be firmly put in place, and should not be removed for at least two weeks after the completion of the arch.

There is some discussion at present as to the relative strengths of gravel and broken stone in concrete, without any decisive results in either case; although the natural inference it to suppose that a rough, irregular surface will secure greater adhesion than one that is smooth. However that may be, there is little reason to doubt that gravel will make a good concrete. But there is a right and wrong way of using gravel. It is not uncommon to find cement, and gravel just as it is taken from the pit, mixed to form a concrete. Remembering the proper composition of a concrete, and placing beside this the fact that gravel usually contains sand, but not in any definite proportions, that some pockets of "gravel" may be almost completely sand, while in the layers adjoining there may be

little if any sand, it will be readily understood why it is that, in some cases, concrete mixed in this way may be successful, yet it will always be uncertain and hazardous. The only safe method is to separate the stone and sand composing the gravel by screening, then to mix cement, sand and stone, uniformly and in their right proportions.

A cause of poor concrete is the excessive amount of water used when mixing. The tendency very often is to bring concrete to the same consistency as common mortar, a very great mistake. Concrete when ready to be placed in the work should have the appearance of freshly dug earth. Where an excessive amount of water is used, the hardened concrete will have an open, spongy texture. The concrete should be mixed close to the work, in a box, which is sometimes specified as water-tight, but the concrete will soon make it so. It should be mixed in just such quantity as is required, and a constant stream kept passing to the work. It should be laid in layers, and each layer thoroughly rammed until moisture appears on the surface.

It is very necessary to see that the sand and stone used in making the concrete are clean, that is, free from clay, loam, vegetable or other matter which will act as an adulterant, and result in a weak and friable concrete. If such matter is intermixed with the stone, it is well to flush it away with a good stream of water. Large stone used in rubble concrete should also be treated in this way. Indeed, it is well, particularly in hot weather, to dampen the stone before mixing it with the mortar. The stone in hot weather causes the moisture of the mortar to evaporate, with the result that it sets too quickly; and at all times there is more or less absorption from the mortar in immediate contact with the stone, unless the stone, as intimated, has been previously dampened.

When the work ceases for the day, or is for other reasons interrupted, the surface should be kept damp until work is resumed. When work is in progress in hot weather, any exposed surfaces should be kept damp and protected from the rays of the sun; otherwise the surface will, in setting too rapidly, be interlaced with hairlike cracks, which filling with water in winter, and freezing, will cause the surface to scale off. The same scaling sometimes results from laying concrete in frosty weather.

Arch culverts of masonry or concrete fail frequently from settlement, caused by an insecure foundation. The foundation should always be of at least sufficient depth to be free from any danger of undermining by the scour of water, and of sufficient further depth to be safe from settlement.

The one element in the construction of concrete work which presents a real difficulty, is the uncertainty with regard to the quality of the cement. The means of performing complete tests are not within the reach of small municipalities, and they are dependent upon the good reputation of the brand employed. Different batches of cement of the same brand differ, as we know, in quality, and sometimes very much to the disadvantage of the user. A brand may be, in general, good. And yet there are lapses now and then, a little carelessness in chemistry perhaps, which cause an occasional lot to be unfit for use. This is a disadvantage which small municipalities have at present to meet; yet it is one which, I feel confident, is growing less, and will continue to grow less as experience in the manufacture of cement reaches a more definite stage. Its use in the construction of highway culverts is a matter with which every member of the Association engaged in municipal work should fully acquaint himself.

DISCUSSION.

This paper is not given the same title as the programme gives it, but that is very frequently the case with papers. It is entitled, "Cement Concrete Culverts."

Mr. Ross—We have this paper before us. I think it is a most seasonable one, and one which, I think, will be of value to nearly every member of our Association. Mr. Campbell was over the ground very thoroughly, and I do not know that there is very much to criticise or add to what he has said; but we would be very glad to hear our members in regard to the paper.

Mr. Sankey—Concrete is now very generally taking the place of stone, especially where stone is difficult to get. In some parts of the country suitable stone for the work is not very plentiful or readily got at. I can vouch for what Mr. Campbell says about the same brand of cement differing most seriously. In Toronto we use an enormous amount of cement in the city works, and it

takes a young man nearly his whole time sampling the cement and testing it. We have samples continually taken from the cement delivered by the contractors on the pavement work to see whether the cement he is using can stand the test. Of course, when the contract is let the specification provides that the cement must stand a certain test. Then each barrel must be carefully tested during the progress of the work to see that it is up to the standard; and in some cases the manufacturers of the cement themselves will not believe when we report that the cement is not up to the standard. They will tell us it is off the same batch, the same burning, and prepared with the same care. We tell them to come and see what has been broken and the official record of those who have broken it, and they will hardly believe their own eyes

Mr. Niven—I do not know enough about such matters to criticize, but I think this is a good paper. There is one thing certain, that some other than wooden culverts must be used, because in many parts of the country it is impossible to get the timber for a wooden culvert, as there is no earthly use in putting in anything but cedar, other timber will only last a few years; and if these cement culverts could be established for the country roads and water courses where they are necessary it would be a great boon.

Mr. Ross—Quite a boon to the path-masters; they would not have to be replacing broken planks.

Mr. Sankey—There is a company known as the Metal Company with the object of introducing this class of structure. They have the most modern machinery for producing the metal. They take sheets of steel of suitable strength, and it is stamped, and when it comes through a stamp it looks like a large fisherman's net. This is used for the strengthening of all concrete work. Quite recently, I understand, they have put up a factory in Montreal. They have carried on some very extensive tests, and the results have been astonishing.

Professor Stewart—The testing of cement at the School of Science is not in my department, but in that of Mr. Wright. In connection with this I was in Peterboro' about a year ago, and met the gentleman who has charge of the cement works on the Trent Valley canal, and he showed me some specimens of concrete that had been broken off after it had set and hardened

thoroughly, and I was astonished at the strength shown by the cement in this broken concrete. It had been broken, I think, by a sledge hammer, and in breaking, instead of the stone separating from the cement, it had broken as if it were a mass of rock instead of a mixture of gravel, broken stone and cement.

Mr. Wilkie—I had a little experience with Portland cement last year. I found that a few barrels were not up to the standard at all. It did not set for thirty-six or forty hours; it was a slow-setting cement. A few weeks after it was apparently as hard as any of the other cements. The manufacturers would have declared that it was exactly the same—no difference whatever. In using Portland cement we cannot be too careful in watching it, and we will get the best results from it.

Mr. Ross—Reliable manufacturers in Canada make very trying tests of the goods they turn out, both chemically and mechanically, and do not send out anything but what they consider first-class in every respect. But I suppose there are some manufacturers not reliable.

Mr. Sankey—With regard to the different brands of cement at present in use in Toronto, we are constantly getting letters from different parts of the country asking how a certain brand has stood our tests, and what test it has stood; and I know the City Engineer is very happy to give any results of his investigation. Of course, in small places the test requires somewhat too expensive machinery, and it also requires personal knowledge to test cement. If any gentleman desires to know what test any particular brand has stood, it is quite easily got by applying to the City Engineer. It might be useful to gentlemen to know in making specifications what cement to call for.

Mr. McLean—In New York city I see the City Engineer has issued a circular, saying that he will conduct any tests that may be asked for by any other municipalities, and will report the result on any of the cements. I do not know whether a thing of that kind could be undertaken here at any of the schools.

Mr. Ross—Do you charge a fee for testing cement?

Mr. Stewart—I think a small fee is charged for making tests.

Mr. Ross—A fee of about $10?

Mr. Stewart—I think it is $5.

Mr. Ross—A testing machine can be purchased from the Fairbanks Company for $130. Those engineers who have only a small amount of work to do would hardly invest in one; but it would no doubt be very helpful for every engineer who has anything to do with cement construction to have one.

Mr. Stewart—The machine used at the school is one made in Philadelphia. It is a 2,000 pound machine, and appears to be very simple in its mode of operation.

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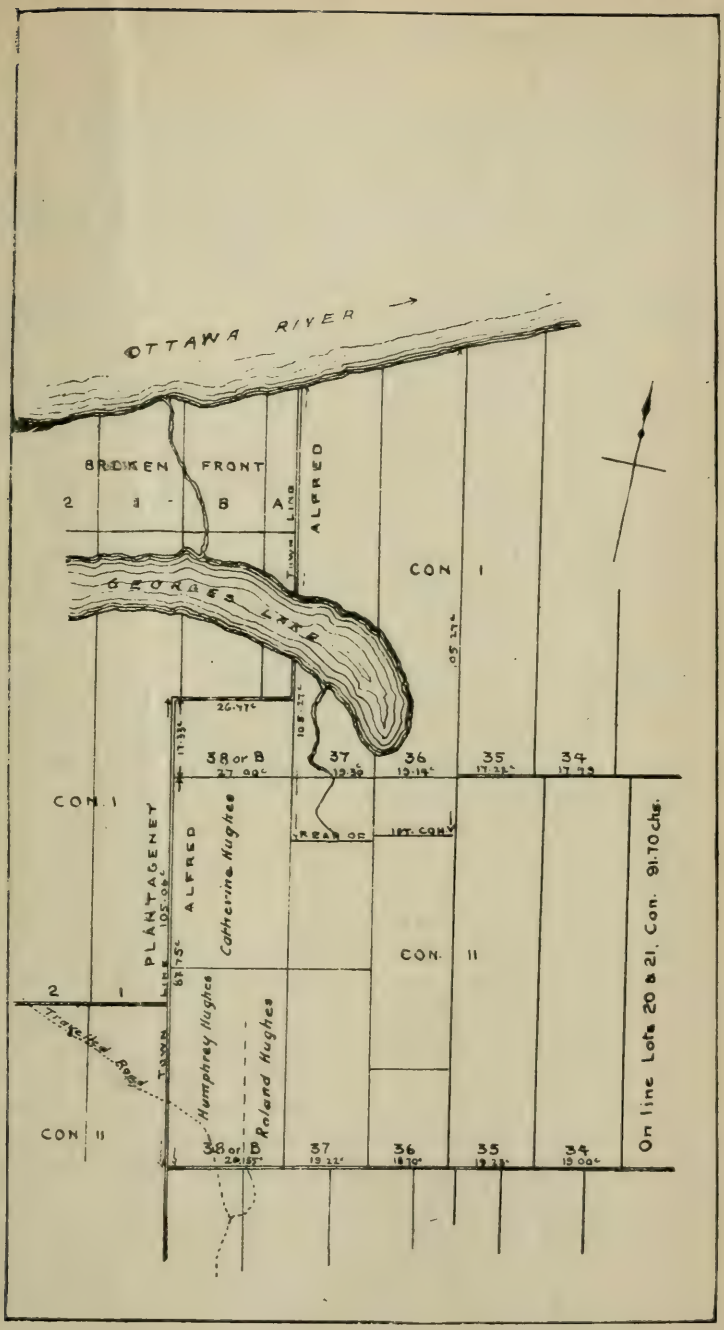
SOME NOTES ON THE ORIGINAL SURVEY OF PART OF ALFRED TOWNSHIP.

By E. T. WILKIE, Carleton Place.

In December, 1898, I was called upon to make a survey of a piece of land in the Township of Alfred, for the purpose of enabling the owner, or rather the squatter, to get a patent for the land in question. I was informed that he had applied to the Crown Lands Department for a patent, and was told that they were not aware that there was any land in that vicinity unpatented, and was instructed to have the piece of land surveyed, and to send the plan and field notes to the Crown Lands' Office, in the usual way, and the land would be patented to him. Hence the survey.

I found that the original survey of the first three concessions of Alfred had been made by Deputy Surveyor J. Fortune, in 1816. In doing the work, which appears to have been done in the summer time, he seems to have started his work at the east side of the township. His notes show that he ran the line in front of the second concession as far as the line lots 20 and 21, there he offset "North 16 deg. west, 104.60 to the Grand River (Ottawa River), in order to run the first short line." Then he ran the line in front of the first concession westward, till he ran into the Grand or Ottawa River, and by making a couple of offsets southwards, to keep out of the river, he got across lot 37. There he established the town line between Alfred and Plantagenet, or as he calls it, "The western boundary line of the Township of Alfred." Then he ran south 16 degs east along this boundary line, "In order to ascertain the distance for to commence the second concession line," but he did not get more than half the distance he wanted till he ran into George's Lake, he then offset eastwards, across lot 37, and again ran south 16 degs. east, and ran into the lake again, and by making a couple more offsets he reached the second concession line, along which he ran eastwards, and appears



PLAN SHOWING TOWN LINE BETWEEN PLANTAGENET AND ALFRED. ACROSS 1ST AND 2ND CONS. ALFRED.

to have struck the point where he stopped the line, between lots 20 and 21, exactly, both for longitude and latitude. Then he appears to have run the line along the front of the third concession from the east side of the township westwards and established the western boundary line of the Township of Alfred south of George's lake, by chainage along that line.

Deputy Surveyor Duncan McDonnell was there in 1836. He seems to have found the line between the second and third concessions of Alfred ran out to the western boundary line. He then ran this boundary line between Alfred and Plantagenet (which he may have found ran as far north as the rear of the first concession of Plantagenet), northwards for 105.27 chains, from which point he ran a line eastwards, parallel to the line between the second and third concessions of Alfred, till he intersected Fortune's town line from the Ottawa River to George's Lake, produced southwards across the lake, which made the town line as I found it and as shown on the accompanying plan.

Some years after McDonell made his survey, W. McConnell, from the Province of Quebec, picked up Fortune's line for the front of the second concession, at the post between lots 35 and 36, the first post he set after offsetting round the lake, and produced it westwards across lots 36, 37 and the commons or (38 or B.), till he intersected McDonell's town line. The portion cut off from the commons or (38 or B.) north of this line, said to contain about forty acres, was the land I was required to survey.

The lands adjoining this town line, in the broken front and first concession of Plantagenet, were patented to The Canada Company, who sold them, describing them by metes and bounds. Part of the description of the commons in the first concession adjoining the eastern boundary of Plantagenet is "Commencing at the water's edge of the Ottawa River, in the western limit of the allowance for road between the Townships of Alfred and Plantagenet, thence south 14 degs. east, 70.38 chains, more or less, to a line run by Deputy Surveyor Duncan McDonell, in 1836, parallel to the line between the second and third concessions of Alfred." Fortune gives the bearing of the line as south 16 degs. east, and I made the distance 70.50 chains, from the line of vegetable growth along the river to McDonell's post.

Lots 36 and 37 in the first concession of Alfred were pat-

ented in 1802 and 1803, respectively, fourteen and thirteen years before Fortune made his survey, each lot being described by metes and bounds, and having side lines south 16 deg. east, the same bearing as Fortune's town line from the Ottawa River to George's Lake, running southwards 105.27 chains from the river, and being 19.22 chains wide. The south half of lot 37 in the second concession of Alfred was patented to Humphrey Hughes, October 15, 1830, as 100 acres, and described by metes and bounds, being 52.63½ chains, more or less, deep, and refers to the adjoining lot on the west side as "Commons." The front or northerly part of lot 37 in the second concession of Alfred was patented to Catherine Hughes, June 25, 1846, as sixty acres and described by metes and bounds, and being 31.60 chains, more or less, deep. Lot 36, in the second concession of Alfred was patented to Rowland Hughes in two pieces, the north or centre vacant part, on October 15, 1830, as 100 acres, described as commencing on the limit between lots 35 and 36, at the distance of 26.31¾ chains from the north-east angle of said lot 36, thence south 16 deg., east 52.63½ chains, etc., the south part, on Aug. 27, 1844, as fifty acres, more or less, and described as commencing in the limit between lots 35 and 36, distant 78.95¼ chains, on a course south 16 deg. east, from the north-east angle of said lot 36, thence south 16 deg., east, 26.31¾ chains, more or less, to the allowance for road in rear of said concession, etc.

It will be seen from the distances given in these patents that the Crown Lands Department believed the concession was 105.27 chains deep, but I only found 87.73 chains from Fortune's second line produced westward to the western boundary and the third concession line. In a former survey I found on the line between lots 20 and 21, the concession to be 91.70 chains wide.

Humphrey Hughes and Catherine Hughes supposed that lot 37 lay adjoining the western boundary of the township and located themselves accordingly, and made their clearings and built their houses and other buildings close to the western boundary line, and they and their descendants are in possession there still. Rowland Hughes, in locating the western boundary of his land measured eastwards along the line between the second and third concessions from the western boundary line of township, the distance given in the patent, of lot 37 as its width, and he or his descendants are in posses-

sion of a strip of the commons, or 38 or B., as shown by the lines which were run afterwards, and as shown on the accompanying plan.

The whole commons, or 38 or B., contains about 277 acres, and at the time I was there none of the occupants had any title to their holdings.

I made my survey, sent my plan and field notes to the solicitor through whom I was engaged to make the survey, who forwarded them to the Crown Lands Department, and I have since been informed that the patent has been issued.

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MEASURING THE DISCHARGE OF RIVERS AND STREAMS AND CALCULATING HORSE POWER.

By VAUGHAN M. ROBERTS.

The development of the natural resources of Ontario has proved to surveyors the necessity of having, in addition to the requirements called for by the "Survey Act," a fair knowledge of more than one branch of civil engineering.

The increasing value of water-powers must, if it has not already done so, compel the Government to issue instructions to all surveyors making government surveys, to measure and report upon all water-powers which may be met with in the course of their surveys.

During the past few months the writer has been so frequently asked the question: "How do you measure the discharge of a river and calculate horse-power?" that an endeavor to answer it in the form of a paper may bring about a discussion which will be beneficial to all.

In finding the discharge of a stream it is necessary to know the area of its wetted perimeter in square feet and its velocity in feet per minute.

In calculating horsepower it is necessary to know the discharge of stream, and the height of fall over which it is discharged.

To obtain the velocity of a stream or river:

1. Select a stretch or reach where the channel is uniform.

2. Lay off a base line along the bank of the river, not less than one hundred feet in length, setting pickets at each end of it; on the opposite bank of the river and at right angles to the base line set two more pickets, one opposite each end of the base line.

3. Take soundings across the river at each end of the base line and one or more in between, according as the length of

the base line and the irregularities of the bed of the river may require, from the cross sections obtained by plotting the soundings, the average area of the wetted perimeter may readily be calculated. When taking soundings, it is always advisable to fix the level of the water by connecting it with some permanent bench mark.

4. Make a series of floats of different lengths; to the end of each fasten a small twig about the thickness of a lead pencil and eighteen inches long, to which attach a piece of paper or flannel; on the other end fasten sufficient weight to submerge the whole float, leaving above water the small twig with paper or flannel flag. Place the floats in the river at different distances from the banks, and above the upper line of pickets; note the time they pass the line of pickets at each end of the base line. If there is any great difference in the time taken going over the course, a second and even third trial should be made and the results thus obtained averaged and reduced to feet per minute.

In measuring velocity, dead water is often found adjacent to each bank of the river and an allowance should be made for this in the area of the wetted perimeter.

The area of the wetted perimeter is the sectional area of the volume of water moving down stream and the velocity is the number of feet this sectional area travels in one minute, the product of the velocity and wetted perimeter is therefore the discharge.

After a number of experiments, James Watt found that the average value of a horse-power was 33,000 foot-pounds per minute, and it is now the recognized unit of horse-power. One horse-power is a force which will raise 33,000 pounds vertically one foot in one minute.

To calculate the horse-power of a river at a fall, it is necessary to know the height of fall, *i.e.*, the difference in level between the slack water above the fall and the slack water below the fall, and the weight of the volume of water flowing over the fall.

FEES.

39. The following fees shall be paid to the Secretary-Treasurer for the use of the association: Tariff of

1. By every person duly authorized to practise as a land surveyor under the provisions of this Act on applying for registration under this Act, the sum of $1.00.

2. By each member of this association an annual membership fee of $4.00.

3. By each apprentice at the transmitting to the secretary the indenture or articles of such apprenticeship, $10.00; 62 Vic. 2., c. 11, s. 18.

4. By each candidate for examination, with his notice thereof, for receiving and entering such notice, $1;

5. By each applicant obtaining a certificate, as a fee thereon, $2;

6. By each applicant receiving a certificate to practise, as an admission fee, $30;

7. By each apprentice with each transfer of articles as a fee for registering same, $2;

8. By each applicant receiving a certificate to practise, being the fee for official notice in the *Ontario Gazette*, $.

55 V. c. 34, s. 7; 69 V. c. 27, s. 26.

A cubic foot of water weighs 62.4 pounds. The formula for horse-power is therefore:

$$\text{One Horse Power} = \frac{\text{Discharge in cubic feet per second} \times 62.4 \text{ lbs.} \times 60 \times \text{head in feet}}{33000}$$

But $\frac{62.4 \times 60}{33000} = .1134$ $\therefore$ one Horse Power = Discharge in cubic feet per second × head in feet × .1134

As an example, we will take the Sturgeon River, in the District of Nipissing, which I have measured on several occasions. The length of base line was 300 feet, the sectional area obtained by soundings, allowance being made for dead water, was 5,900 square feet, the velocity of stream taken by submerged floats, three trials being made (the length of the floats being about two-fifths the depth of water), was .375 feet per second.

The discharge of the river was therefore 5,900 sq. ft. × .375 ft. per sec. = 2,212.5 cu. ft. per sec., the head was 40 feet.

Horse-power = 2,212.5 × 40 × .1134 = 10,035.9.

DISCUSSION.

Mr. Ross—Mr. Robert's paper is before you for discussion. It is quite a clear, simple and reasonable paper, and we might have a short discussion on it.

Mr. Speight—This is certainly a good, practical paper. These matters are coming very much to the front during the past year, as the Local Governments are placing considerable weight upon water powers in Ontario, and I think it is a very good thing they are, and the ordinary surveyor will have no difficulty in working out the problem. I hope that it will be helpful to all of us.

Mr. Van Nostrand—I claim a little of the credit of instigating this paper, because I had occasion to look into a matter of that kind for a small calculation of water power, and I did not know exactly how to go about it in the best practical way; and, knowing that Mr. Roberts had recently had experience of this kind, I asked him to explain it, and he explained it so lucidly that I thought it would be a good thing to have it put in a paper.

There are very many practical hints in it; and I understand from Mr. Roberts that the results have stood the tests of calculation by some very prominent engineers, and his method was upheld, although differing in results from the other people, they afterwards came to his way of thinking.

Mr. Niven—It is a very practical and useful paper. It is one, too, which should be used on surveys, for surveyors run across water power, and it would be a very good thing to know what the volume is, and all about it. It does not appear to be a very difficult process; any person could easily pick it up and use it. I move that it be received and printed in the Proceedings.

Mr. Speight—I second that motion.

LIST OF MEMBERS.

31st July, 1900.

The names of those members granted exemption by By-laws ratified by the Association are marked*.

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

Abrey, George Brockitt, Ignace, Dist. of Rainy River.....10th Jan., 1860
D.L.S.

Allan, John Richard, Renfrew.....6th Nov., 1894
Grad. S.P.S.

Aylsworth, Charles Fraser, Jr., Madoc.....8th Jan., 1886
D.L.S.

Aylsworth, John Sidney, Selby, P.O. Box 23...9th Jan., 1871
D.L.S.

Aylsworth, William Robert, Belleville, P.O. Box 2.....8th Nov., 1861
D.L.S.

Baird, Alexander, Leamington.....7th July, 1877
D.L.S., C.E.

Barrow, Ernest George, Hamilton.....4th Oct., 1877
D.L.S., Mem. Can. Soc. C.E., City Engineer.

Bazett, Edward, Burk's Falls.....8th July, 1881
D.L.S.

Beatty, David, Parry Sound.....12th July, 1869
D.L.S.

Beatty, Herbert John, Eganville.....8th Nov., 1893
Grad. S.P.S.

Beatty, Walter, Delta.....19th July, 1858
D.L.S., M.P.P.

Bell, James Anthony, St. Thomas.....11th Oct., 1875
D.L.S., Co. Engineer, Elgin. City Engineer, St. Thomas.

Bigger, Charles Albert, Ottawa, 68 Daly Ave..6th Jan., 1882

Bolger, Thomas Oliver, Kingston.....6th July, 1865
D.L.S., City Engineer.

Bolton, Ellsworth Doan, Listowel.....7th Nov., 1899
B.A.Sc. (McGill)

Bolton, Jesse Nunn, Toronto, 264 Major St.....6th April, 1867
D.L.S.

Bolton, Lewis, Listowel.....9th July, 1864
D.L.S.

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

Boswell, Elias John, Peterborough.....7th Nov., 1896
Grad. S.P.S.

Bowman, Clemens Dersteine, West Montrose. 10th July, 1879

Bowman, Herbert Joseph, Berlin.....7th Jan., 1887
D.L.S., Grad. S.P.S., Treasurer County Waterloo. Assoc. Mem. Can. Soc. C.E.

Bray, Edgar, Oakville.....6th Oct., 1866
D.L.S.

Bray, Harry Freeman, Oakville.....10th July, 1882

Bray, Samuel, Ottawa, Dept. of Indian Affairs..6th Jan., 1877
C.E., D.L.S.

Brown, George Laing, Morrisburg.....19th Feb., 1898
Grad. S.P.S.

*Brown, John Smith, Kemptville.....8th July, 1852
D.L.S.

Browne, Harry John, Toronto, 18 Toronto st..6th July, 1872
C.E.

Browne, William Albert, Toronto,
18 Toronto st.....10th April, 1876

Burt, Frederick Percy, New York, N.Y.....8th July, 1885
Manager and Treasurer Engineering News Pub. Co., 220 Broadway.

Butler, Matthew Joseph, Napanee,
P.O. Box 359.....11th Jan., 1878
M.I.C.E., Mem. Am. Soc. C.E., Mem. Can. Soc. C.E., C.E.

Byrne, Thomas, Sault Ste. Marie.....15th July, 1862
D.L.S.

Caddy, Cyprian Francis, Campbellford.....10th July, 1860
D.L.S.

Caddy, John St. Vincent, Ottawa, 559 King st..6th Oct., 1866
D.L.S.

Cameron, Alfred John, Peterborough.....9th April, 1889

Campbell, Archibald William, Toronto,
Parliament Building .....10th April, 1885
C.E. Provincial Instructor in Road Making.

Carpenter, Henry, Stanley, B.A., Sc.
(Toronto Univ.), Collingwood.....25th Feb., 1899

Carre, Henry, Belleville, P.O. Box 203.....8th Nov., 1861
City Engineer, B.A. and C.E. (Trin. Coll., Dublin), D.L.S.

Carroll, Cyrus, Prince Albert, Sask.....10 Jan., 1860
Mem. Can. Soc. C.E., D.L.S.

Casgrain, Joseph Philippe Baby, Morrisburg...5th Jan., 1887
D.L.S., P.L.S., (Que.) C.E., Assoc. Mem. Can. Soc., C.E., Chief Eng.
M. & P.J. Ry.

Cavana, Allan George, Orillia.....8th July, 1876
D.L.S.

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

Chalmers, John, Port Arthur, per Ont. & R.R. R'y Co.....14th April, 1896
Grad. S.P.S.

Charlesworth, Lionel Clare, Rat Portage.....14th April, 1896
Grad. S.P.S, Agent Bureau of Mines, (Ont.)

*Cheesman, Thomas, Mitchell.....11th July, 1856
D.L.S.

Chipman, Willis, Toronto, 103 Bay st.....4th Oct., 1881
B.A. Sc. (McGill), Mem. Am. Soc., C.E.; Mem. Can. Soc. C.E.

Code, Abraham Silas, Alvinston.....14th April, 1896

Cozens, Joseph, Sault Ste. Marie.....7th July, 1875
D.L.S.

*Davidson, Alexander, Arkona.....11th Oct., 1858
D.L.S.

Davidson, Walter Stanley, Sarnia.....9th April, 1884

Davis, Allan Ross, Napanee.....8th Jan., 1886
B.A.Sc. (McGill.)

Davis, John, Alton.....5th April, 1878

Davis, William Mahlon, Berlin.....11th April 1885
Grad. R.M.Coll., (Kingston), Town Engineer.

Deacon, Thomas Russ, Rat Portage.....12th Nov., 1892
Grad. S.P.S., Town Engineer, Mgr. Mikado Mine.

Deans, William James, Oshawa.....11th July, 1884

DeMorest, Richard Watson, Sudbury.....9th April, 1889
M.E.

Dickson, James, Fenelon Falls.....6th April, 1867
D.L.S.

Dobbie, Thomas William, Tilsonburg.....11th July, 1856
D.L.S.

Dobie, James Samuel, Port Arthur.....21st Feb., 1898
B.A.Sc. (Toronto Univ.)

Doupe, Joseph, Winnipeg, Man., 169 Edmonton st.....13th Jan., 1863
D.L.S., P.L.S. (Man.), C.E. (McGill).

Ducker, William A., Winnipeg, Man., 334 Pacific ave.....6th April, 1882
D.L.S., P.L.S. (Man.) Swamp Lands Com.

Esten, Henry Lionel, Toronto, 157 Bay st....7th Jan., 1887

Evans, John Dunlop, Trenton.....8th July, 1864
D.L.S., C.E., Chief Eng. Cent. Ont. Ry., Eng. for Weddell Bridge & Engine Works.

Fair, John, Brantford.....13th April, 1875

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

Fairbairn, Richard Purdom, Toronto,
127 Major st.....7th Oct., 1876
Surveyor for Dept. of Pub. Works, Ontario.

Fairchild, Charles Court, Simcoe.....9th April, 1894
Grad. S.P.S.

Fairchild, William Howard, Simcoe.....17th Feb., 1900

Farncomb, Alfred Ernest, Fort William.....9th April, 1895

Farncomb, Frederick William, London,
213 Dundas st.....6th Nov., 1889

Fawcett, Thomas, Niagara Falls.....6th Jan, 1881
Dom. Topographical Surveyor.

Fitton, Charles Edward, Orillia, Box 142....10th April, 1879
D.L.S.

FitzGerald, James William, Peterborough,
Box 333.....13th July, 1857
D.L.S.

Flater, Frederick William, Petrolea.....9th April, 1888

Ford, William Butterton, Hamilton,
42 James St., N.....21st Feb., 1898

Francis, John James, Sarnia P.O., Box 304...16th Oct., 1861
D.L.S.

*Fraser, Charles, Wallaceburg.....5th Aug., 1847
D.L.S

Galbraith, William, Bracebridge.....4th April, 1883
D.L.S.

Gamble, Killaly, Toronto, 88 Charles st.....6th April, 1888
D.L.S., P.L.S. (Man.), Captain R.A. (Ret'd)

Gardiner, Edward, St. Catharines.....6th Jan., 1866
D.L.S.

Gaviller, Maurice, Collingwood, Box 164.....6th Jan., 1866
C.E. (McGill), D.L.S.

Gibson, Harold Holmes, Willowdale.....8th Sept., 1891

*Gibson, James Alexander, Oshawa.....7th April, 1855
D.L.S.

Gibson, Peter Silas, Willowdale.....19th July, 1858
C.E.,M.S. (Mich. Univ.) D.L.S., Mem. Can. Soc. C.E., Engineer Tp. of York.

Gibson, Wilbert Silas, Willowdale.....21st Feb., 1898

Gillon, Douglas John, Fort Frances.....9th Nov., 1895
Grad. R.I.E. Coll.

Graydon, Aquila Ormsby, London.....8th July, 1880
City Engineer.

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

Griffin, Albert Dyke, Woodstock,
P.O. Box 612.....11th Nov., 1890

Hanning, Clement George, Preston,
Lock Box 130.....19th July, 1858
D.L.S., C.E, (Trin. Coll., Dublin).

Hart, Milner, Toronto, 103 Bay st.....11th July, 1863
D.L.S.

Harvey, Thomas Alexander, Steelton, Penn...13th Nov., 1893
C.E. (R.P.I., Troy, N.Y.)

Heaman, John Andrew, London,
Albion Building.....16th Nov., 1896

Henry, Frederick, London, Albion Building..7th April, 1887

*Hermon, Royal Wilkinson, Rednersville....13th July, 1857
D.L.S.

Hobson, Joseph, Montreal, G. T. Rv. Office.....3rd Oct., 1855
D.L.S., Chief Eng. Grand Trunk Railway System.

Hopkins, Marshall Willard, Rat Portage....13th Nov., 1893
B.A.Sc. (McGill), Assoc. Mem. Can. Soc. C.E., Chief Engineer I.R.R.C.

Hutcheon, James, Guelph.....10th Nov., 1891
Grad. S.P.S., City Engineer.

Irwin, James Moore, Rat Portage..... 13th Jan., 1863
D.L.S.

James, Darrell Denman, Toronto,
77 Victoria St.....3rd Nov., 1891
B.A., B.A.Sc. (Toronto Univ)

Jones, Charles Albert, Petrolea.....8th April, 1881
D.L.S.

Jones, John Henry, Sarnia, Box 194.....10th Oct., 1886
D.L.S.

Jones, Thomas Henry, Brantford.....10th Oct., 1878
B.A.Sc. (McGill). D.L.S., City Engineer.

*Keefer, Thomas Coltrin, Ottawa.....14th Aug., 1840
D.L.S., C.E.

Kennedy, James Henry, St. Thomas.....7th April, 1887
C.E. (Toronto Univ.), Mem. Can. Soc. C.E., Engineer of V.V. & E. Ry.

Kippax, Hargreaves, Huron, South Dakota...7th July, 1877
C.E. (Toronto Univ), Assistant to Surveyor-General.

Kirkpatrick, George Brownly, Toronto,
Dept. of Crown Lands.....13th April, 1863
D.L.S., Director of Surveys.

Laird, James Stewart, Essex.....6th April, 1867
D.L.S.

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

Laird, Robert, Rat Portage.....11th Nov., 1887
Grad. S.P.S.

Lewis, John Bower, Ottawa, Brunswick House .....4th Oct., 1883
D.L.S., P.L.S. (Quebec), C.E.

Lougheed, Aaron, Port Arthur.....12th Nov., 1888
D.L.S.

*Low, Nathaniel Edward, Wiarton.....11th July, 1856
D.L.S.

Lumsden, Hugh David, Toronto, 63 Homewood ave.....4th Jan., 1866
C.E., D.L.S., M.I.C.E., Mem. Can. Soc. C.E.

Macdougall, Allan Hay, Port Arthur.....11th April, 1859
D.L.S., Town Engineer.

MacKay, James John, Woodstock.....25th Feb., 1899

MacKenzie, William, Sarnia.....11th April, 1896
Grad. R.M.C. (Kingston).

MacKenzie, William Lyon, Cranbrook, B.C.....7th April, 1887
C.E.

MacPherson, Duncan, Montreal, P.Q.....9th Jan., 1884
Grad. R.M.C., M.I.C.E., Mem. Can. Soc. C.E., Div. Eng. Eastern Div. C.P. Ry.

McAree, John, Rat Portage.....6th April, 1867
Dominion Topographical Surveyor, B.A.Sc., (Toronto Univ.)

McCubbin, George Albert, St. Thomas, City Engineer's Office..... .....9th Nov., 1895
Assist. City Engineer.

McDonell, Augustine, Chatham, 4 & 5 Ebert's Block.....11th July, 1863
D.L.S.

McDowall, Robert, Owen Sound.....11th Nov., 1890
Grad. S.P.S., Town Engineer

McEvoy, Henry Robinson, St. Marys.....10th July, 1875
D.L.S.

McFadden, Moses, Neepawa, Man.....13th April, 1858
D.L.S., P.L.S. (Man.)

McFarlen, George Walter, Toronto, Court House.....11th Nov., 1889
Grad. S.P.S.

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

McGeorge, William Graham, Chatham, Box 225.....8th Jan., 1866
D.L.S.

McGrandle, Hugh, Huntsville.....5th Jan., 1883
D.L.S.

McKay, Owen, Windsor, P.O. Box 167.....7th Jan., 1887
Grad. S.P.S., Chief Eng. D. & L. E. Ry.

McKenna, John Joseph, Dublin.....9th July, 1860
D.L.S.

McLatchie, John, Nelson, B.C., P.O. Box 128....9th Jan., 1864
D.L.S., P.L.S. (Que., Man. and B.C.).

McLean, James Keachie, Elora.....8th April, 1876
D.L.S.

McLean, William Arthur, Toronto, Parliament Buildings .....21st Feb., 1898
Secretary of Roads.

McLennan, Murdoch John, Williamstown...13th Nov., 1893
B.A.Sc. (McGill), D.L.S.

McLennan, Roderick, Toronto, 115 Avenue Rd.....20th June, 1846
D.L.S.

McNab, John Duncan, Owen Sound.....9th Oct., 1879

McNaughton, Finlay Donald, Cornwall.....25th Feb., 1899

McPherson, Archibald John, Brockville.....10th April, 1897
B.A.Sc. (Toronto Univ.)

McPherson, Charles Wilfrid, Barrie.....21st Feb., 1899

McPhillips, George, Windsor.....9th July, 1885
D.L.S., P.L.S. (Man.)

Manigault, William Mazyck, Strathroy, P.O. Box 300.....8th July, 1876
D.L.S.

Marshall, James, Holyrood.....6th Oct., 1866
D.L.S.

Meadows, William Walter, St. Thomas.....21st Feb., 1898
Grad. S.P.S.

Miles, Charles Falconer, Rat Portage, Hilliard House.....13th Jan., 1862
D.L.S.

Miller, Frederick Fraser, Napanee.....8th Jan., 1885

Moore, John MacKenzie, London, Albion Building.....9th Oct., 1879

Moore, John Harrison, Smith's Falls.....11th Nov., 1889
Grad. S.P.S.

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

Morris, Alfred Edmund, Perth.....10th April, 1879

Morris, James Lewis, Pembroke.....7th July, 1886
D.L.S., C.E. (Toronto Univ

Mountain, George Alphonse, Ottawa.....9th Jan., 1884
Mem. Can. Soc. C.E., D.L.S., P.L.S. (Que.) Chief Eng. Can. Atlantic and O.A. & B. Ry.

Murdoch, William, Toronto, 37 Bloor St. E.....10th Jan., 1860
D.L.S., C.E.

Murphy, Charles Joseph, Toronto, 157 Bay st..6th Oct., 1886

Newman, John James, Windsor.....21st Feb., 1898

Newman, William, Windsor,
57 Sandwich st. w.....12th Nov., 1892
Grad. S.P.S.

Niven, Alexander, Haliburton.....8th July, 1859
D.L.S.

Ogilvie, William, Dawson City, Yukon Dist..12th July, 1869
D.L.S. Commissioner for Yukon District.

O'Hara, Walter Francis, Chatham.....14th April, 1892
D.L.S.

Paterson, James Allison, Sauzon, P.Q. .....5th April, 1878
C.E., Mem. Can. Soc. C.E.

Patten, Thaddeus James, Little Current.....5th Jan., 1883

Peterson, Peter Alexander, Montreal, P.Q...16th July, 1863
D.L.S., C.E., Mem. Can. Soc. C.E., Chief Engineer Can. Pac. Ry.

Pinhey, Charles Herbert, Ottawa,
630 Wellington ave.....12th Nov., 1888
D.L.S., Grad. S.P.S., Assoc. Mem. Can. Soc. C.E.

Proudfoot, Hume Blake, Port Arthur .....6th Jan., 1882
D.L.S., C.E. (Toronto Univ.)

Rainboth, Edward Joseph, Ottawa.....11th Nov., 1887
D.L.S.

Rainboth, George Charles, Aylmer, P.Q.....11th July, 1868
D.L.S., P.L.S. (Que.)

Reinhardt, Carl, Montreal, 340 Mountain St.....25th Feb., 1899
B.A.Sc. (McGill.)

Reynolds, Samuel Henry, Rat Portage.....17th July, 1880

Roberts, Vaughan Maurice, St. Catharines...5th April, 1887

Robertson, James, Glencoe.....11th July, 1885
Grad. S.P.S.

Robinson, Franklin Joseph, Barrie.....21st Feb., 1898
Grad. S.P.S.

Roger, John, Mitchell.....10th Nov., 1888
Grad. S.P.S.

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

*Rombough, Wm. R., Toronto, 61 Walton St...14th Nov., 1848
D.L.S.

Rorke, Louis Valentine, Sudbury.....14th April, 1890
D.L.S.

Ross, George, Welland.....10th July, 1879
B.A.Sc. (McGill), D.L.S.

*Rubidge, Tom S., Cornwall.....9th Feb., 1849
D.L.S., Asst. Eng. Dept. Rys. and Canals.

Russell, Alexander Lord, Port Arthur.....16th April, 1873
D.L.S., P.L.S. (Que.).

Sankey, Villiers, Toronto, City Hall.....11th Jan., 1878
D.L.S., City Surveyor.

Saunders, Bryce Johnston, Fort William.....7th Jan., 1885
B.A.Sc. (McGill), D.L.S.

Scane, Thomas, Ridgetown.....7th Jan., 1865
D.L.S.

*Schofield, Milton C., Guelph.....28th Sept., 1843
D.L.S.

Schwitzer, John Edward, Rat Portage.....16th Nov., 1896
B.A.Sc. (McGill.)

Seager, Edmund, Rat Portage.....8th July, 1861
D.L.S.

Selby, Henry Walter, Dinorwic,
Dist. of Rainy River.....8th Jan., 1876
D.L.S.

Sewell, Henry DeQuincy, Rat Portage.....9th July, 1885
D.L.S., A.M.I.C.E.

Shaw, John Henry, Pembroke.....17th Feb., 1900
Grad. S.P.S.

Silvester, George Ernest, Sudbury.....12th Nov., 1892
Grad. S.P.S

Sing, Josiah Gershom, Meaford, P.O. Box 3.....9th Jan., 1879
D.L.S.

Smith, Angus, Stratford.....14th April, 1896
Grad. S.P.S., City Engineer.

Smith, George, Woodville, P.O. Box 77. ...7th April, 1881
Engineer for Co. Victoria and four Townships.

Smith, Henry, Toronto, Crown Lands Dept...8th Nov., 1861
D.L.S., Mem. Can. Soc C.E.

Speight, Thomas Bailey, Toronto,
Yonge St. Arcade.....6th Jan., 1882
D.L.S.

Squire, Richard Herbert, Brantford,
103 Dalhousie St.....14th April, 1896
B.A.Sc. (Toronto University).

Steele, Edward Charles, Port Arthur.....9th April, 1889
Assoc. Mem. Can. Soc. C.E.

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

Stewart, Elihu, Ottawa, Dept. of the Int.....8th April, 1872
D.L.S., Chief Inspector of Timber and Forestry.

*Stewart, George Alexander, Calgary, Alta....8th July, 1852
D.L.S.

Stewart, John, Montreal.....11th Nov., 1887
D.L.S.

Stewart, Walter Edgar, Aylmer.....12th April, 1892

*Strange, Henry, Rockwood.....30th Nov., 1838
D.L.S., C.E

Stull, William Walter, Sudbury.....17th Feb., 1900
B.A.,Sc. (Toronto Univ.)

Taylor, William Verner, Gananoque .....7th Nov., 1896
Grad. S.P.S.

Tiernan, Joseph Martin, Tilbury Centre.....7th Jan., 1886

Traynor, Isaac, Dundalk.....16th April, 1873
D.L.S.

Turnbull, Thomas, Winnipeg, Man.,
C. P. R. Eng. Office.....6th July, 1878
D.L.S., C.E. (Toronto Univ.)

Tyrrell, James Williams, Hamilton,
42 James st. n.....8th April, 1885
C.E. (Toronto Univ.), D.L.S , Co. Eng. for Wentworth

*Unwin, Charles, Toronto, 126 Seaton st....12th April, 1852
D.L.S.

Ure, Frederick John, Woodstock.....7th April, 1887
C.E.

Van Buskirk., William Fraser, Rosland .....7th April, 1888
Grad. R. M. Coll., (Kingston), City Engineer.

Van Nostrand, Arthur J., Toronto,
Yonge St. Arcade..... .....30th Oct., 1882
D.L.S.

Wadsworth, Vernon Bayley, Toronto,
103 Bay st.....9th April, 1864
D.L.S.

Wagner, William, Ossowo, Man.....13th April, 1858
D.L.S.

Walker, Alfred Paverley, Toronto, Room 508,
Union Station, C. P. Ry., Eng. Office.....6th Jan., 1882
D.L.S., Mem. Can. Soc. C.E.

Wallace, James Nevin, Hamilton,
119 Hunter St., N... .....21st Feb., 1898
B.A., B.E. (Trin. Coll. Dublin).

Ward, Archeson Thomas,
Wabigoon Dist. of Rainy River .....10th April, 1897

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

Warren, James, Walkerton, P.O. Box 190.....7th Oct., 1864
D.L.S.

Watson, John McCormack, Orillia,
P.O. Box 224.....13th April, 1892

*Weatherald, Thomas, Goderich,
P.O. Box 273.....12th Jan., 1856
D.L.S., C.E.

Weekes, Melville Bell, Brantford.....17th Feb., 1900
B.A.Sc. (Toronto Univ.)

West, Robert Francis, Orangeville.....7th April, 1881

Wheelock, Charles Richard, Orangeville.....7th Jan,, 1886
Treasurer County of Dufferin.

Whitson, James Francis, Toronto,
Crown Lands Dept.....9th Jan., 1886

Wicksteed, Henry King, Cobourg.....7th Jan., 1886
D.L.S., C.E.

Wiggins, Thomas Henry, Cornwall.....10th Nov., 1891
Grad. S.P.S., D.L.S., Town Engineer.

Wilde, John Absalom, Sault Ste. Marie.....9th April, 1889

Wilkie, Edward Thomson, Carleton Place...11th April, 1891
D.L.S.

Williams, David, Fort William West ..... 9th April, 1864
D.L.S.

*Winter, Henry, Thornyhurst.....11th July, 1853
D.L.S., C.E.

*Wood, Henry O., Billings' Bridge.....10th Oct., 1855
D.L.S.

*Yarnold, William Edward, Port Perry,
P.O. Box 44.....7th April, 1854
D.L.S.

REGISTERED AND WITHDRAWN.

The names of those who have become "Associates" under By-law No. 39 are marked*.

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

Anderson, John Drummond, Trail, B.C.....13th April, 1892

Apsey, John Fletcher,
Cumberland, Md.....6th Jan., 1886
Grad. S.P.S.

Aylsworth, Charles Fraser, Sr., Madoc.....2nd April, 1861
D.L.S.

Blake, Frank Lever, Toronto,
Meteorological Office .....13th April, 1875
D.L.S.

Bell, Andrew, Almonte.....6th Oct., 1866
D.L.S.

Booth, Charles Edward Stewart,
Westmount, P. Q.....6th April, 1882

Bowman, Arthur Meyer, Mahan,
Beaver Co., Pa.....11th Nov., 1887
Grad. S.P.S., Staff of U.S. Engineers.

Bowman, Franklin Meyer, Bellevue,
Allegheny Co., Pa.....11th April, 1892
Grad. S.P.S., Engineer Structural Iron Works.

Brady, James, Victoria, B.C., P.O. Box 815..15th July, 1862
M.E.

Burnet, Hugh, Victoria, B.C.....5th April, 1887
P.L.S. (B.C.).

Cambie, Henry John, Vancouver, B.C.....8th July, 1861
P.L.S. (B.C.).

Carbert, J. Alfred, St. Joseph, Mich.....7th April, 1876
D.L.S. Staff of U. S. Engineers.

Coleman, Richard Herbert, Toronto, Canada
Co. Offices, Imperial Bank Chambers....6th Oct., 1877

Drewry, William Stewart, Ottawa,
Dept. of the Interior.....5th April, 1883
D.L.S.

Edwards, George, Thurso, P.Q.....6th Jan., 1866
D.L.S.

*Ellis, Henry Disney, Kuching, Sarawak,
Borneo .....7th April, 1877
D.L.S., Commr. of Pub. Works and Surveys.

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

Galbraith, John, Toronto,
School of Prac. Science.....13th April, 1875
M.A., D.L.S., Prof. Engineering S.P.S.

Gibbons, James, Ottawa, Dept. of the Interior...15th April, 1890
Grad. S.P.S., Dominion Topographical Surveyor.

Gibson, George, St. Catharines.....10th April, 1860
D.L.S.

*Gilmour, Robert, Toronto, c/o Western
Loan Company.....11th April, 1856
D.L.S., C.E

Green, Thomas Daniel, Dawson City .....7th Jan. 1885
D.L.S.

*Harris, John Walter, Winnipeg .....6th Oct., 1866
P.L.S. (Man.), D.L.S., Assessment Com.

Henderson, Eder Eli, Henderson P.O.,
Maine .....7th April, 1887
Grad. S.P.S.

Hermon, Ernest Bolton, Vancouver, B.C.....7th Oct., 1885
P.L.S. (B.C.), D.L.S.

Innes, William Livingstone, Simcoe.....14th April, 1892
C.E., (Toronto Univ.)

James, Silas, Toronto, 77 Victoria St..... .....19th July, 1858
D.L.S.

Jephson, Richard Jermy, Calgary, Alta.....7th April, 1877
P.L.S. (B.C.), D.L.S.

Johnson, Sydney Munnings, Greenwood, B.C..9th Nov., 1895

Johnston, Robert Thornton,
New York, N.Y., 944 Amsterdam Ave.....9th April, 1889

Kains, Tom, Victoria, B.C.....11th July, 1873
D.L.S. P.L.S. (B.C.).

Kirk, John Albert, Rossland, B.C.....6th July, 1877
D.L.S., P.L.S. (B.C.)

Klotz, Otto Julius, Ottawa, 437 Albert st.....6th Jan., 1876
C.E. (Mich. Univ.), Dominion Topographical Surveyor.

Lane, Andrew, Sparrow's Point, Md.....4th April, 1895
Grad. S.P.S., Draftsman Maryland Steel Co.

Lendrum, Robert Watt,
South Edmonton, Alta.....8th Jan., 1874
D.L.S.

Livingstone, Thomas Chisholm,
Winnipeg, Man.....10th Jan., 1859
D.L.S.

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

MacLeod, Henry Augustus F., Ottawa,
340 Cooper st.....11th Oct., 1856
C.E., D.L.S.

McCulloch, Andrew, Lake Nelson, B.C.....
Grad. S.P.S., Assoc. Mem. Can. Soc. C. E., City Engineer.

*McMullen, William Ernest,. St. John, N.B..11th Nov., 1892
Asst. Eng. C. P. Ry.

Magrath, Charles Alexander, Lethbridge, Alta..1st Nov., 1881
B.A.Sc. (McGill), D.L.S., P.L.S. (B.C.).

Moore, Thos. Alexander, London South....12th Nov., 1892

Munro, John Vicar, New York, N.Y.,
359 West 31st st.....9th April, 1895

Pearce, William, Calgary, Alta.....12th Oct., 1872
D.L.S., P.L.S. (B.C.).

Ponton, Archibald William, Ottawa,
Dept. of Interior.....9th April, 1880
D.L.S.

Pope, Robert Tyndall, —— —— Ireland.....13th April, 1875
C.E., D.L.S.

Purvis, Frank, Mesa City, Arizona.....7th April, 1875

Reid, John Lestock, Prince Albert, Sask.....8th April, 1870
D.L.S.

Reiffenstein, James Henry, Ottawa,
Dept. of the Interior.....16th April, 1873
D.L.S.

Reilly, William Robinson, London,
361 Simcoe st.....7th April, 1881
D.L.S., P.L.S. (Man.)

Ritchie, Nelson Thomas, Kipiegan, Man.....9th Nov., 1888

Rogers, Richard Birdsall, Peterborough.....9th Jan., 1879
B.A.Sc. (McGill), D.L.S.

Ross, Joseph Edmund, New Westminster,
B.C. .....11th Nov., 1890
P.L.S. (B.C.).

Sanderson, Daniel Leavens, Coral, Mich.....4th Oct., 1882

Shaw, Charles Æneas, Greenwood, B.C.....6th Oct., 1877
P.L.S. (B.C.).

Sherman, Ruyter Stinson, Vancouver, B.C..12th April, 1890
P.L.S. (B.C.).

Simpson, George Albert, Winnipeg Man.....7th Oct., 1864
C.E., D.L.S., M.P.

Spry, William, Toronto.....19th July, 1858
C.E., D.L.S.

*Stewart, Louis Beaufort, Toronto,
School of Prac. Science.....6th April, 1882
Dominion Topographical Surveyor. Lect. in Surveying.

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

Strathern, John, Vancouver, B.C. ..... 5th Oct., 1876
P.L.S. (B.C.), D.L.S.

Tracey, Thomas Henry, Vancouver, B.C. .... 8th April, 1870
C.E., P.L.S. (B.C.), D.L.S

Vicars, John Richard Odlum, Kamloops, B.C. . 5th Jan., 1887
D.L.S., P.L.S. (B.C.).

Wallace, Charles Hugh, 36 Dame St., Dublin, Ire., 9th Nov. 1889
C.E. (Trin. College, Dublin), Dom. Gov. Surveyor.

Weekes, Abel Seneca, Wetaskiwin, Alta .... 12th April, 1890
D.L.S.

Wheeler, Arthur Oliver, New Westminster,
B.C. ..... 8th July, 1881
P.L.S. (B.C.), D.L.S.

Willson, Alfred, Toronto, Can. Co. Offices,
Imperial Bank Chambers ..... 6th Oct., 1866
D.L.S., Commissioner Canada Company.

Wilkins, Frederick William, Ottawa,
Dept. of the Interior ..... 6th Jan., 1877
Dominion Topographical Surveyor.

SUMMARY.

Active members subject to dues	205
Active members exempted from dues	18
Withdrawn from practice (including Associates)	63
Dead	30
Total number enrolled since incorporation	316

Deceased Members.

NAME.	LATE RESIDENCE.	DATE OF P.L.S. CERTIFICATE.	DATE OF O.L.S. REGISTRATION.	DIED.
Bolger, Francis	Lindsay	10th October, 1863	1892	3rd November, 1895
Bowman, Leander Meyer	Toronto	14th April, 1892	1892	20th September, 1895.
Brown, David Rose	Cornwall	10th October, 1850	1892	14th May, 1900.
Burke, William Robert	Ingersoll	5th April, 1878	1892	10th June, 1897.
Caddy, Edward C.	Cobourg	28th December, 1840	1892	26th September, 1897.
Coad, Richard	Glencoe	8th October, 1870	1892	17th May, 1897.
Cresswicke, Henry	Barrie	8th July, 1864	1892	22nd January, 1898
Cromwell, Joseph M. O	Perth	1st October, 1846	1892	19thOctober, 1897
Deane, Michael	Windsor	26th May, 1848	19th December, 1892	3rd April, 1897.
DeGarse, Joseph	Windsor	7th April, 1883	1892	22nd March, 1898.
Foster, Frederick Lucas	Toronto	6th April, 1863	1892	27th July, 1899.
Fowlie, Albert	Orillia	13th January, 1863	1892	— April, 1898.
Gibbs, Thomas Fraser	Adolphustown	31st May, 1841	1892	17th April, 1893.
Gilliland, Thomas Brown	Eugenia	11th July, 1868	25th January, 1896	14th December, 1898.
Haskins, William	Hamilton	5th July, 1855	1892	5th July 1896.
Hewson, Thomas Ringwood	Hamilton	6th July, 1877	1892	21st October, 1898
Howitt, Alfred	Gourock	12th January, 1856	1892	6th May, 1896.
Kirk, Joseph Green	Stratford	16th February, 1843	1892	22nd January, 1900.
Lynch-Staunton, Francis H	Hamilton	11th October, 1856	1892	11th June, 1899.
MacMillan, James Alexander	Calgary	6th January, 1877	24th December, 1894	— ——, 1898.
MacNab, John Chisholm	Hamilton	8th January, 1880	1892	16th October, 1897.
McCallum, James	Fort Frances	30th March, 1849	1892	— July, 1900
Malcolm, Sherman Morgan	Blenheim	11th October, 1858	1892	13th January, 1899.
Ogilvie, John Henry	Rat Portage	8th April, 1876	24th April, 1894	21st September, 1898.
Pedder, James Robert	Doon	10th November, 1891	23rd December, 1892	17th January, 1897.
Reid, James Hales	Bowmanville	6th October, 1866	1892	22nd December, 1899.
Robinson, William	London	— May, 1846	1892	11th October, 1894.
Thomson, Augustus Clifford	Chicago	14th January, 1861	1892	— December, 1896.
Walsh, Thomas William	Simcoe	25th April, 1842	1892	14th March, 1895
Wheelock, Charles John	Orangeville	—— ——, 1856	1892	4th July, 1897.

OBITUARY.

JOSEPH GREEN KIRK.

Joseph Green Kirk was one of the oldest and best known of the early settlers in the county of Perth, Ontario. His illness, which extended over several years, did not confine him to the house until the beginning of this year. He was born in Londonderry, Ireland, on September 12, 1809. He was educated by a private tutor, his studies having special reference to his chosen calling, that of a civil engineer. In 1829 he left Ireland for Canada, settling in Bytown, now the City of Ottawa, where he practised under Mr. John Robertson, a civil engineer of that place. In 1843, having received a commission to practise as a land surveyor, he moved to Goderich, and shortly afterwards to Stratford. In 1845 he was appointed engineer for the Huron district, comprising the Counties of Perth, Huron and Bruce of to-day. When the district was separated into counties his duties were confined to the County of Perth. He resigned this office in 1872, and devoted himself mainly to a private practice. In 1878 he was employed by the Town of Guelph, in 1884 by the Town of Minnedosa, Man., and for many years in Stratford and adjacent municipalities in his professional capacity, having charge of local improvements in those places. In 1837 he volunteered as a private in the militia. In 1847 he received a commission as a Lieutenant in the 4th Battalion of the Huron militia, and was connected with the 1st Perth Battalion holding the rank of Captain. A commission as Justice of the Peace was given him in 1858. In the early days of Stratford he sat in the Council. He was a member of St. Andrew's Presbyterian Church, and filled the position of elder for many years. He died at his home in Stratford on 22nd January 1900. In private life quiet and unselfish he was endeared to all who knew him.

He leaves a widow and one son, Mr. J. A. Kirk, of Rossland, B. C. Two sisters also survive him, living near Ottawa.

Rev. Stat. c. 180, s. 28 amended.
Shortened term of apprenticeship.

1. Section 28 of *The Ontario Land Surveyors' Act* is amended by inserting after the word "engineering," at the end of the fifth line thereof the words, "or the School of Mining, Kingston, in civil engineering or in mining engineering." 63 V. c. 22, s. 1.

See page 11, Sec. 28 Manual.

Rev. Stat. c. 181, s. 39 amended.

22. Section 39 of *The Surveys Act* is amended by adding the following subsections thereto:—

Allowance for road when closed to belong to adjoining owner.
Rev. Stat. cc. 136, 138

(4) Where under subsection 1 of this section any allowance for a road or street laid down upon a plan is a public highway but the municipal corporation has not assumed the same for public use, then in case the said allowance or any part thereof is closed by an alteration of the plan under section 110 of *The Registry Act*, or section 111 of *The Land Titles Act*, or other provision in that behalf, the allowance so closed shall belong to the owners of the lands abutting thereon.

How owners of abutting lands to take.

(5) Where several parcels of land having different owners abut on the allowance so closed, the owner of each parcel shall be entitled to the portion of the allowance so closed on which his land abuts, and shall be so entitled to the middle line of the said allowance, and where there are several owners of an abutting parcel each shall be entitled to the like estate or interest in the said portion of the allowance as he has in the parcel of land abutting thereon.

When allowance abuts on one side on a stream, etc.

(6) Where any portion of the allowance so closed is abutted on one side by another road or street, or by a stream, river or other body of water over which the public have rights of navigation or of floating logs the whole width of such portion shall belong to the owners whose lands abut thereon opposite the said street, stream, river or water.

Division line.

(7) The division line between two adjoining parcels produced to the middle line of the closed allowance or across such allowance in cases coming within subsection 6 shall be the division line between the portions of the closed allowance to which the owners of the said parcels shall be respectively entitled.

When incumbrancers to be deemed owners.

(8) A person who has an incumbrance on a parcel of land abutting on the allowance closed shall be deemed an owner of such parcel within the meaning of the four next preceding subsections. 63 V. c. 17, s. 22.

See page 33, Sec. 39 Manual.

OUR LATE BELOVED QUEEN.

BORN MAY 24th 1819. DIED JANUARY 22nd, 1901.

AGED 81 YEARS.

This was her Majesty's most recent portrait, and was taken at her special command by Lafayette. She is shown wearing the shamrock on her bonnet.

No. 16.

ANNUAL REPORT

OF THE

ASSOCIATION

OF

Ontario Land Surveyors

ORGANIZED 1886. INCORPORATED 1892.

AND

PROCEEDINGS

AT THE

NINTH ANNUAL MEETING

SINCE INCORPORATION

HELD AT

TORONTO

26th, 27th and 28th February, 1901.

PRINTED FOR THE ASSOCIATION BY
HENDERSON & CO., LOMBARD STREET,
TORONTO.

PATRONIZE OUR ADVERTISERS.

NOTICES.

Members and others will be supplied with copies of the Annual Reports for 1886, 1887, 1888, 1889, 1891, 1892, 1893, 1894, 1895, 1896, 1897, 1898, 1899, or 1900, upon remitting to the Secretary fifty cents, for each copy required.

Copies of the "Manual" may also be had from the Secretary, price fifty cents.

Each member of the Association is reminded of the fact that for the next Annual Meeting a good programme is most desirable, and to insure its preparation it is not now too early to bear the matter in mind.

In addition to its use as a library, the Repository now serves as a drafting room for members when copying Crown Lands plans and notes.

Published annually by the Association of Ontario Land Surveyors. Edition, 1350 copies; price, 50 cents.

PATRONIZE OUR ADVERTISERS.

PREFACE.

To the Members of the Association of Ontario Land Surveyors:

The Proceedings of the Association at its Ninth Annual Meeting are herewith presented.

There are no additions to the "Manual" this year, but at page 197 will be found the Regulations, etc., relating to the admission of Land Surveyors, which will be found convenient.

Respectfully submitted on behalf of the council.

VILLIERS SANKEY,
Secretary.

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ASSOCIATION OF

ONTARIO LAND SURVEYORS

(INCORPORATED 1892)

Organized 23rd February, 1886.

OFFICERS FOR 1901-1902.

PRESIDENT.

JAMES DICKSON, - - - - - - - Fenelon Falls.

VICE-PRESIDENT.

W. R. AYLSWORTH, - - - - - - - Belleville.

CHAIRMAN OF COUNCIL.

GEORGE B. KIRKPATRICK, O.L.S., - - - - Toronto.

SECRETARY-TREASURER.

MAJOR VILLIERS SANKEY, O.L.S., - - - - Toronto.

MEMBERS OF COUNCIL.

J. W. TYRRELL, Hamilton.
J. MCARCE, Rat Portage. } For Term ending April, 1904.

A. J. VANNOSTRAND, Toronto.
C. A. JONES, Petro ea. } For Term ending April, 1903.

G. B KIRKPATRICK, Toronto.
A. NIVEN, Haliburton, } For Term ending April, 1902.

AUDITORS.

CAPT. GAMBLE, - - - - - - - - Toronto.
A. J. VANNOSTRAND, - - - - - - - Toronto.

BANKERS.

Imperial Bank of Canada (Yonge Street Branch), Toronto.

BOARD OF EXAMINERS.

G. B. Kirkpatrick, (Chairman), A. Niven, P. S. Gibson, M. Gaviller, B. J. Saunders, M. J. Butter, V. Sankey, (Sec.)

NOTE—Board meets at Crown Lands Department, Parliament Buildings, Toronto, on Monday, February 10th, 1902.

COMMITTEES, 1901-1902.

STANDING.

LAND SURVEYING—J. D. Evans, (Chairman). H. S. Carpenter, A. R. Davis, R. W. DeMorest, M. Gaviller, H. H. Gibson, A. Niven, A. S. Russell.

DRAINAGE—C. A. Jones, (Chairman), F. W. Farncomb, F. W. Hater, W. G. McGeorge, J. H. Moore, Geo. Ross.

ENGINEERING—E. G. Barrow, (Chairman), A. W. Campbell, Jas. Hutcheon, R. McDowall, F. F. Miller, A. P. Walker, Jas. Warren.

ENTERTAINMENT—A. P. Walker, (Chairman), Willis Chipman, H. L. Esten, H. H. Gibson, H. DeQ. Sewell, V. Sankey, J. F. Whitson.

PUBLICATION—K. Gamble, (Chairman), H. J. Browne, H. L. Esten, W. A. MacLean, A. J. Van Nostrand.

TOPOGRAPHICAL SURVEY—L. B. Stewart, (Chairman), Otto J. Klotz, M. J. Butler, Willis Chipman.

SPECIAL.

POLAR RESEARCH—Willis Chipman, (Chairman), Jos. Cozens, C. J. Murphy, Wm. Ogilvie, L. B. Stewart, J. W. Tyrrell, J. F. Whitson.

EXPLORATION—J. W. Tyrrell, (Chairman), Alex. Baird, D. Beatty, John McAree, Jas. Robertson, G. E. Silvester, T. B. Speight, E. Stewart.

REPOSITORY AND BIOGRAPHY—A. J. Van Nostrand, (Chairman), Willis Chipman, R. P. Fairbairn, P. S. Gibson, T. H. Jones, G. B. Kirkpatrick, C. Unwin.

PROGRAMME OF THE

Association of Ontario Land Surveyors

(INCORPORATED.)

AT ITS NINTH ANNUAL MEETING HELD AT TORONTO.

26th, 27th AND 28th FEBRUARY, 1901.

PROGRAMME.

Tuesday, 26th February—Morning, 10 oclock.

AT THE REPOSITORY, PARLIAMENT BUILDINGS.

Meeting of Council.
Meeting of Standing and Special Committees.

Afternoon, 2 o'clock.

President's Address.
Report of Secretary-Treasurer.
Report of Committee on Repository and Biography. A. J. Van Nostrand, Chairman.
Report of Committee on Publication. K. Gamble, Chairman.

Evening, 8 o'clock.

(At Repository)

Paper—"Engineers and Surveyors." A. R. Davis.

Wednesday, 27th February—Morning, 10 o'clock.

AT ENGINEERS' CLUB ROOMS, 94 AND 96 KING ST. WEST.

Report of Council. G. B. Kirkpatrick, Chairman.
Paper—"Surveys and Plans for Municipalities." H. J. Bowman.
Discussion—"Duties of Surveyors as Referees."
Report of Land Surveying Committee and Question Drawer. W. R. Aylsworth, Chairman.

Afternoon, 2 o'clock.

"Regulation of the Level of Lake Erie." F. W. Farncomb.
Report of Drainage Committee and Question Drawer. A. S. Code, Chairman.
Discussion—"Reclamation of Lands under the Several Drainage Acts."
Report of Engineering Committee. M. J. Butler, Chairman.
Report *re* Standard of Measure. V. Sankey.

Evening, 8 o'clock.

ANNUAL DINNER. MCCONKEY'S RESTAURANT.

Thursday, 28th February—Morning, 10 o'clock.

AT ENGINEERS' CLUB ROOMS, 94 and 96 KING ST WEST.

Report of Topographical Survey Committee. Otto J. Klotz.
Paper—"Topographic Photography." J. N. Wallace.
Discussion—"Track Surveying."
Report of Exploration Committee, "Digest Northern Ontario Explorations." L. B. Stewart, Chairman.
Report of Committee on Entertainment. H. L. Esten, Chairman.

Afternoon, 2 o'clock.

Nomination of Officers (President, Vice-President, Secretary-Treasurer, Auditors, two members of Council.
Ratification of By-Laws.
Unfinished Business.
New Business.
Adjournment.

Minutes of the Ninth Annual Meeting

OF THE

ASSOCIATION OF

ONTARIO LAND SURVEYORS,

Held at the Repository, Parliament Buildings, Toronto, on FEBRUARY 26th, and at the Engineers' Club Rooms, 94 and 96 King Street East, Toronto, on FEBRUARY 27th and 28th.

MORNING SESSION.

Meeting of the Standing and Special Committees.

Repository, February 26th, 1901.

The Ninth Annual Meeting opened at 3 p.m., the President, Mr. Ross, in the chair.

The Minutes of the previous meeting as printed in the Proceedings for 1900 were taken as read.

The President then read his address, in which he fittingly referred to the death of Her late Majesty Queen Victoria. After some discussion it was moved by Mr. Aylesworth, seconded by Mr. Kirkpatrick, that the address be received and printed in the Proceedings. Carried.

Mr. Kirkpatrick, referring to the death of Her late Majesty requested the Chairman to name a Committee to draft an address of condolence to His Majesty King Edward the Seventh, to be forwarded through the proper channel, that it may be laid at the foot of the throne.

The Chairman named Messrs. Kirkpatrick, Dickson and Aylesworth. Carried.

The report of the Committee on Repository and Biography was presented by Mr. A. J. Van Nostrand, and on motion, was received and ordered to be printed.

The report of the Committee on Publication was presented by Capt. Gamble, and on motion, was received and ordered to be printed.

Mr. Sankey brought up the subject of the preparation of papers for the Annual Meeting. After some discussion it was decided to request the Chairmen of the several Committees, to take up the matter early in the year, and communicate with those members most likely to contribute.

The meeting adjourned until 8 p.m. at the Repository.

Evening Session.

Tuesday, 26th, February 1901, 8 o'clock p.m.

Mr. George Ross, President.

Mr. Villiers Sankey, Secretary.

Paper by Mr. A. R. Davis (Napanee), entitled "Engineers and Surveyors."

Mr. Davis:—Mr. President and gentlemen: The object of this paper is to assist in paving the way for the closer union of our civil engineers and surveyors. For the sake of the argument I suggest to the meeting, "The Canadian Association of Civil Engineers and Surveyors," with a question mark. Reads paper.

The President then tendered the thanks of the Association to Mr. Davis for his very valuable contribution.

Mr. Davis:—I thank you, Mr. President and Gentlemen, for the kind reception you have given the paper. It was practically a new field for me to travel, and I wrote to two or three members of this Association, for some hints in reference to the matter, men who I knew knew more about the matter pertaining to the union of the two professions than I did. But I found that "mum" was the word. I got no replies. Then I took the course that I thought looked most reasonable, and while giving vent to certain thoughts, in reference to this question, that have been prominent in my mind for a number of years, I endeavored as far as possible to avoid the extremes that sometimes injure the cause more than they help it.

I am very much pleased with the very fair and excellent feeling that prevails among the members of the Association in reference to this amalgamation. There is no question that we (Surveyors and Engineers) are practically members of the same profession. In my experience as a Surveyor and Civil Engineer I am running across every year Surveyors and Engineers from

the Atlantic to the Pacific—I meet them in the Maritime Provinces and in all the other Provinces. I will give you one illustration of the feeling that exists: During last summer while on Railway Work I came into the camp of a Surveyor belonging to one of our neighboring Provinces, in the employ of a rival Railway Company—my camp was near his, and we were both aiming for the same pass between the mountains; in fact his Company had located its line, and this Surveyor was taking some right-of-way notes—he was a stranger to me, a man I had never seen before. I called him by name, passed the time of day, and said, That I came to see him in regard to their location as I wished to avoid crossing it; I thought there was room enough in the country for both of us; and I asked him if he would kindly give me some information. He invited me into his camp; and got out his plan of location, and said, "Here, take this and make a copy of it; you can do it over in your own camp—here is our location." I said, "This is very kind of you; there is no indication of any bitterness towards the employes of your rivals." "Oh," said he, "That is all right; if the heads of our companies require to get at logger-heads, well and good; we men in the field cannot afford to dispute over these matters, we have enough troubles of our own." He treated me very kindly and invited me over to dinner the next day, and we had a sociable time. Such are the men we are meeting as Surveyors and Engineers, a common brotherhood from the Atlantic to the Pacific; and they are as intelligent men as you can meet anywhere in this Dominion to-day; and yet they are apart, they are separate; there is a line of cleaveage running all along, although this is a new country, as Mr. Chipman says, and there are only a few men employed in the profession. The rising generation, the young men who are entering the profession can be qualified for whatever work we have to do; and the examinations can be made such as to meet the requirements, all can meet on common ground, and we will strengthen ourselves and strengthen the calling; and make ourselves a name that will be honored throughout the Dominion, and as with all other professions, the standard of our profession will be raised and we will not suffer. We should not lower our standard but rather elevate it; and certainly consolidation will have a tendency to elevate, if it be carried out on right principles. (Applause).

Moved by Mr. Sankey, seconded by Mr. Bowman that the new council shall appoint a Committee to be known as the

"Legislation Committee," to take up matters concerning amalgamation of the Surveyors and Engineers, or as the case may be.

The President put the motion, and, on a vote having been taken, declared it carried.

A Paper by Mr. Klotz on the Deflection of the Plumb Line.

Mr. Sankey:—There are two plans connected with this paper, and I think if I pass them round so that they may be seen the paper which I am about to read will be more easily understood. Mr. Klotz sent this printed copy of the paper to the Association; he has already read the paper before the Ottawa Literary and Scientific Society, and I took it upon myself to write, asking him if he had any objection to the paper being read before this Association and published in our proceedings, as it seemed to be one of very great interest to Surveyors in general. I got a very nice letter from him, saying he would be very much pleased, and very proud if we would do him the honor of reading his paper and publishing it in our proceedings.

Mr. Sankey reads the paper.

Mr. Aylesworth moved, seconded by Mr. Davis that the paper as read be received and published in the Minutes of our Proceedings and that a vote of thanks be tendered to Mr. Klotz.

The President put the motion, and, on a vote having been taken declared it carried.

Adjourned to Wednesday, 27th February, 1901, at 10 o'clock a.m., at the Engineers Club, 94-96 King St., West, Toronto.

Morning Session.

Wednesday, 27th February, 1901, 10 a.m., at the Engineers Club, 94-96 King Street, West.

The President called the meeting to order.

Report re Standard of Measure.

Mr. Sankey:—Mr. President and Gentlemen, the object I have in making this a verbal report rather than bringing it in in connection with the official reports is, that it would be well now for us to consider if any other suggestions should be made with

regard to our standard tape. In the report of last year's Proceedings the matter is dealt with as it was discussed; and at the end of the discussion is was moved by Mr. Aylesworth and seconded by Mr. Ross, that the Board of Examiners be recommended to adopt a 33-foot steel tape as the standard of measurement to be given in future to those who pass the final examination. The President added the suggestion that a sufficient number might be purchased to allow the older members to get them at a nominal figure and hoped that they would be able to do so. Mr. Wilkie said, "For myself I should be very glad to purchase one, and I think with Mr. Sankey that the 33-foot would be the most suitable. I do not anticipate any trouble in comparing the length of my 100-foot chain with the 33-foot standard." Following that instruction out, immediately after the last annual meeting I opened communications with the various manufacturers of steel tapes through their agents or representatives in Toronto. After a good deal of correspondence we found that Chesterman would not make anything out of the ordinary run of tapes he was making. He would sell us 50-foot or 33-foot tapes, just as he had them in stock. And some of the manufacturers in the United States took the same position. Finally the Lufkin Rule Company of Saginaw stated that they would make a tape according to our pattern if we would order one hundred of them. We found on enquiry that the tapes would cost about $4 apiece. We have not yet ascertained whether we can get them in free of duty, or not. Neither Mr. Kirkpatrick, the Chairman of the Council, nor I, felt justified in giving an order that would entail the expenditure of so much money; but we said we would guarantee an order of $100 worth of tapes, and undertake to make this tape the Association standard, that is, we would not go anywhere else to get them made. On that understanding, the Lufkin Rule Company have sent me this tape which I have in my hand as a pattern; it is made on the design that was furnished to me. Now that you have the tape stretched out, you will see that on the face, at the front end the foot is divided into inches, 8ths and 16ths, with the half inch divided further on. There is one improvement I suggest, and that is to get the zero taken out, so that the graduations would be perfectly clear. On the other side of the tape, the link is divided into 10ths and 100ths, merely. Then, we have our own stamp on it, "O.L.S. Standard." At the box end of the tape, the foot is divided into 10ths and 100ths. These tapes will cost $4 net.

There is one advantage with regard to the 33-foot length: it cannot be very well used to make a survey, and it is not intended for that purpose; it will also test the 33-foot and 50-foot link tape at the same time, as they are coincident at the end of the proposed tape.

In order to see how we could get a proper standard, from our Canadian standpoint, the manufacturers sent a sample to Ottawa some time in August last, to get a proper comparison of this tape with the Dominion Land Standard, or really the Department of the Interior Standard, but their mural Standard is broken down, and they cannot compare a tape so long as 33-feet. For that reason I am not able to issue any tapes as yet, and will not be able to do so until we get them stamped so that they will be official for Canada.

Mr. Sewell:—Is it the intention to have the Dominion stamp on them also, so that they will apply as standards for Ontario and the Dominion ?

Mr. Sankey:—Yes; so that it cannot be said that the Ontario Land Surveyors' tapes are not standard with the Standard of the Inland Revenue Department.

In making the change from our old rooms to the new ones, I happened to strike a bundle of papers that were without endorsement, and on looking into the bundle I found what I had been looking for for a long while; and it would be interesting to read these letters, in order that they may be published. You will remember that yesterday evening at the meeting I had the bronze bar which is the original standard of the Ontario Land Surveyors, and has been in the possession of the various Commissioners of Crown Lands for many years.

The first letter I will read is from Troughton & Sims, of Fleet Street, London, written to Mr. W. H. Price, Esquire, Crown Lands, Toronto, Canada, and is dated 14th September, 1850, and reads as follows:—

138 Fleet Street, London, 14th Sept., 1850.

SIR,

We forwarded by the "Mississippi" which sailed on the 20th ult. for New York, a case containing the two Scales for which we were favored with your order by letters of the 18th and 22nd of April last.

The case was addressed to the care of Mr. S. R. Kelly, Commission Merchant, Wall Street, New York, and we hope the Scales will reach you in safety and prove satisfactory.

The Standard Yard was carefully compared with the Tabular Standard Scale of the Royal Astronomical Society and the result of the comparison makes it .000008 of an inch longer than the middle 3 feet, or Standard Yard upon that Scale.

Many years ago Mr. Edward Troughton, for insertion in Dr. Kelly's Cambist, compared a number of foreign with our English measure and amongst the rest an old French Foot, which he found equal to 12.7893 English Inches. Now according to this determination, the Scale of 3 French feet should measure 38.3679 inches upon the Royal Astronomical Society's Scale, and we have satisfaction in reporting that our comparisons make it exceed that length by $\frac{1}{25000}$ of an inch only.

The temperature at which the comparisons were made was between 64° and 66° of Fahrenheit's Thermometor, but as all the Scales are made of brass this is of little or no consequence.

We remain, Sir,

Your most obedient servant,

TROUGHTON & SIMMS.

Mr. Sankey:—That shows that this bar of ours was properly compared in England.

In 1875 a considerable correspondence took place between the Commissioner of Crown Lands in Ontario and the Commissioner of Inland Revenue in Ottawa on the subject of having our Ontario Tapes properly stamped. That correspondence is probably not very interesting to us; it goes into the question as to whether the Dominion held entire control of measures which nobody of course now contradicts. There is a letter here of September 17th, 1877, written by Mr. A. W. Brunell, Commissioner, that I think is most important; it is as follows:—

OTTAWA, September, 19th, 1877.

SIR,

1. Having completed the verification of your standard bar it was delivered to Mr. Murphy on Monday and I have now the pleasure to enclose an indenture of the verification.

2. You will observe that your bar is somewhat short of the standard length but the error is so small as to be of no importance in relation to its practical use.

3. Nevertheless I think it is desirable that all measures used as standards of comparison should have their exact value strictly defined. I have therefore taken considerable trouble in defining the exact value of this particular standard which is perhaps the most important of any lineal standard used in the Province of Ontario.

4. I may observe that the defining lines on your bar as compared with those on the Dominion Standard are so coarse

that it became necessary to measure their breadth and on doing so I discovered a measurable difference between the two defining lines. This difference is equal to .00057559 inch and I have therefore computed the length of the bar to the centre of the defining lines.

5. I am very glad to have had the opportunity of making these comparisons and shall endeavor to obtain similar comparisons of the Surveyor's Standards used in the other Provinces.

I have the honor to be, Sir,

Your obedient servant.

A. W. BRUNEL, *Commissioner.*

In view of these letters and the fact that the mural Standard at Ottawa is broken down, the Board of Examiners suggested that we should find out from Mr. Stewart of the School of Science whether they have any instrument there from which this comparison could be made by us; and he tells me there will be no difficulty at all in comparing our bronze standard with a 33-foot tape, the idea being that the Secretary of the Board shall keep that tape as a standard in his possession, with the record of its length made on the comparator up at the School of Science. Then every tape that is issued is to be compared with that 33-foot steel tape and stamped accordingly. We will stamp on the face of the tape our own Ontario Land Surveyors' mark; and each tape will be numbered so that a record may be kept of those to whom the tapes are issued.

The Council suggested that the next step to be taken would be for the Commissioner of Crown Lands to get authority from the Dominion Government for the Secretary of the Board of Examiners to be an inspector for the purpose of marking Ontario Land Surveyors' tapes, now that we are in actual possession of a properly compared standard.

These I think are the principal points that I was going to put in my paper which I did not expect to have to read until this afternoon; but as Captain Bernier is to lecture before the meeting it was thought well to bring the matter up at this morning's Session. If there are any suggestions to be made as to the marking of the tape or otherwise I would be very glad to get them.

Mr. Dickson.—I think stamping the certificate on the tape is a good idea. At present if a certificate is lost the owner of the tape has nothing to show that there was a certificate with it; the number even is not on the tapes now.

Mr. Sankey:—Mr. Unwin, the late partner of Messrs. Murphy & Esten, had the Dominion Standard with a certificate; and Messrs. Esten & Murphy found they would have to get the tape re-registered in their own names before it would be official for them to use it for Dominion Lands work. I suppose from that that there was some method of marking the tape. The idea I had in my mind was to etch a number on the tape, somewhere near the front of it, and open a register which would show, for instance, that Mr. James Dickson got tape No. so and so on such a day; but I did not propose to issue any tape that fell short of or was longer than the stamped standard; of course it would be utterly impossible for us to give a certificate that any tape like this was .006 long at a temperature of 40 degrees, or anything of that kind.

Mr. McDowall:—Who would be allowed to manufacture these tapes ?

Mr. Sankey:—These tapes, which will be the standard, will be manufactured by the Lufkin Rule Company; they will be issued to Surveyors to test any other tapes or chains they want to use, in the same way as they are supposed to use the old wooden stick.

Mr. McDowall:—Did you say "supposed ?"

Mr. Sankey:—I did say "supposed." The only use I have ever seen those old sticks put to was to put through a strap on a theodolite box to help a man to carry it along through the bush.

Mr. McDowall:—Do you think in the life time of that tape we might have the metric system in force.

Mr. Sankey:—I do not know about that. There is quite a movement in Toronto to bring about the adoption of it; but I have heard some practical men, both Engineers and Surveyors, say that they did not at present see how either Great Britain or the United States can spend money necessary to alter every machine process that is used in the United States and England; because all the screw cutting machinery of those two great countries would have to be thrown into the waste heap. Whether the change to the metric system will come about in our day or not I do not know.

Some years ago, when it was being discussed, I addressed this meeting on the idea of using decimal measures altogether and doing away with inches and the division of the inches into 8ths, using instead 10ths and 100ths. I fancy a great many

Surveyors do use decimal tapes altogether as I notice in descriptions that acres and 100ths of acres are used, and many Surveyors in this part of the country now give their descriptions in feet and 10ths. But the difficulty I met with there was I found the practical man, the carpenter, said, I cannot get wood cut to feet and 10ths. I have to get it cut to inches and 8ths, because the machinery for cutting wood is graduated in that way. I find too that the iron men say, Plates are all rolled that way and bolts are made that way, and the threads to the inch in screws are all cut as so many 16ths or 32nds., etc. If there is a possibility of changes in these modes of measurement happening in a short while, the metric system may possibly be adopted.

Mr. Sewell:—The fact is that feet and inches are more convenient for sub-division than a decimal system; when you come to machinery twelve is much more convenient for sub-division than ten; when you get your feet into decimals it is a very awkward thing and there is no absolute correctness.

Mr. McDowall:—There would be no room on a tape to put a metric system.

Mr. Sankey:—Yes, if it became necessary, there is the back of the far end of the tape. We could use the last link on the back of the tape, and substitute a meter there. These manufacturers have all the plates to do that. You can get a plate graduated on one side in feet and inches and on the other side into meters and 10ths. There would be no difficulty about that at all. But those already in possession of these tapes would find it difficult to have the alteration made.

Mr. McDowall:—That is what I mean.

Mr. Sankey:—The tapes would have to be sent back to the manufacturers.

President Ross:—Why not buy a new tape.

Mr. McDowall:—Yes, I suppose the tapes would be pretty well worn.

Mr. Sankey:—I wish Mr. Butler were here because he has taken quite an interest in this matter and could have told us of some practical experience he has had lately. He was getting out a specification for a building on some German principle that was all worked out in meters and decimeters; and I forget now how many reams of foolscap it took to get out the measurements he required, for the workmen who were going to build. He says

it was an awful job; that he had to take out the measurements to two or three places of decimals every time; and he showed us one or two little calculations that filled most of a page of foolscap. If one had a large specification to get out in that way it is easy to see how great the difficulty of changing from one system to the other would be.

Mr. Sewell:—It would be an endless job. The change is not likely to come in our life-time nor in the life-time of our grandchildren.

Mr. H. J. Bowman:—Do you propose to charge $4 for one of these tapes ?

Mr. Sankey:—Yes.

Mr. Dickson:—Are we likely to get them in free of Duty ?

Mr. Sankey:—We may possibly get them in free under the head of scientific instruments.

Mr. Dickson:—They would be government supplies.

Mr. H. J. Bowman:—If the metric system should be adopted in say ten or fifteen years from the present time I suppose we could stand the price of another standard and probably it would be better to have one then any way. In the meantime it seems to me it would complicate matters to have links, and feet, and meters all on the same standard. If the metric system is adopted, which no doubt it will be in time, because like everything else the system of measurement should be uniform throughout the world; and if Germany and France and the other Continental countries have come to that standard there is no reason why England and the United States should not do so as well. I think some of the difficulties at least will gradually fade away. But it seems to me for the present time we had better just have feet and links, and when the metric system is adopted, if it ever is, the old systems will have to be dropped. It is a question whether in measuring land we should not drop one or the other now. There is no doubt that the method of expressing areas in chains and links is very convenient. Young Surveyors are apt to think chains and links are out of date; but as we go on in practice we gradually drop the feet and inches, as more difficult to apply than chains and links. Feet and inches are not in the decimal system, whereas chains and links are; and the mere fact of chains and links being so much more convenient shows us how much easier the metric system will be for all measurements after a while when all is on the decimal system.

Mr. Sewell:—There is one great objection to the metric system: it is based on latitude in Paris; our yard is based on Greenwich, practically being the swing of a seconds pendulum at a temperature of 62 Fahrenheit at Greenwich, so that we have always in British Territory the standard of the yard. If we had the metric system and we chanced to be at war with France we couldn't get a standard.

Mr. H. J. Bowman:—Mr. Sewell is very patriotic. I will not be behind him in patriotism but I want to remind him that the question is not whether we should adopt a standard that is derived in Paris or in Greenwich, but the decimal system. We have this system in our currency, and we do not consider ourselves unpatriotic. We no longer have to wade through pounds, shillings and pence, but we have the United States method of dollars and cents and it is a very good method too. All we want, after a while, is to have the decimal system carried out for our measurements, both superficial and cubic, so as to apply it to everything. I think, speaking on the matter of patriotism, as we have adopted the decimal system in currency we might use it in everything else without in any way being thought disloyal to the great Empire of which we form a part.

Mr. Sewell:—We have the decimal system in use. There is our Surveyors' chain, which is a four rod chain, and is based on the English yard. I object to our adopting a French standard as in the metric system, not because it is decimal, but simply because the data by which it is arrived at is outside of British Territory.

Paper: "Surveys for Municipalities" by Mr. H. J. Bowman.

Mr. Bowman:—The title of this paper, according to the programme is "Surveys and Plans for Municipalities;" but I found out as I went along that probably one-half of the paper was sufficient at the present time, so I have omitted "Plans" and the title will now stand, "Surveys for Municipalities."

"Moved by Mr. Aylesworth, seconded by Mr. Dickson, that the paper be referred to the Legislation Committee and printed in the minutes and that the thanks of the Association be tendered to Mr. Bowman," the President put the motion, and, on a vote having been taken, declared it carried.

The President tendered the thanks of the Association to Mr. Bowman.

Mr. Bowman:—Thank you, Mr. President.

The President called on Mr. Aylesworth to present the report of the Committee on Surveying.

Mr. Aylesworth:—Your Committee on Surveying has nothing special to report this year. The Chairman of the Committee wrote to most of the members of the Committee to present papers, but he has not received any papers. The Committee has had under consideration and begs to submit the following conclusions;

Read answers to questions 1, 2 and 3, which were illustrated by Mr. H. H. Gibson on the blackboard. On motion answers to questions 1, 2 and 3 were approved of by the meeting.

12.35 p.m., adjourned to 2 o'clock p.m.

Afternoon Session.

Wednesday, 27th February, 1901, 2 o'clock p.m.

The President called the meeting to order.

Mr. Aylesworth concluded the reading of the report of the Surveying Committee, and on motion the several answers to the questions therein contained were adopted.

Moved by Mr. Gibson, seconded by Mr. Dickson, that the report of the Committee be adopted as amended. Carried.

Captain Bernier here delivered his lecture.

President Ross:—Captain Bernier has not only exhibited his views but he has shown us that he knows what he is talking about, and seems to appreciate our sympathy. We desire to show him that we are deeply interested in this work and that we would be glad if the Government granted him the funds necessary to equip his expedition.

I would like to hear from any one present or to receive any motion any one has to make with regard to this matter.

Mr. Tyrrell:—We have all been delighted with the address which Captain Bernier has favored us with this afternoon, and the beautiful views to which we have been treated. I do not propose at all to give anything in the way of remarks myself but merely to express my deep appreciation of the address which I consider admirable. We as Canadians should be proud of Captain Bernier and should certainly give him our support in every tangible way.

As he intimated, I did, a couple of years ago, express my belief in his enterprise; and I can only reiterate that fully this afternoon. Captain Bernier is undoubtedly on the right track. It is proven beyond question that the drift is as he has indicated and it seems to me that the whole problem of reaching the Pole is after all a simple one now that we have the light thrown upon the subject by such a man as Nansen whom most of us have had the pleasure of hearing.

I am sure we all wish Captain Bernier every success, and it would afford some of us much pleasure, to see an Ontario Land Surveyor a member of his party. I should be only too glad, if I were at liberty to do so, to volunteer my own services.

I have much pleasure in moving a hearty vote of thanks to Captain Bernier for his kind address.

Mr. Dickson:—I am sure we are all under an obligation to Captain Bernier for having taken the trouble to come here and address us to-day. It is something I have read a great deal about, but I am no sailor myself, and personally I know nothing about the drift. But I have always taken a great interest in Polar expeditions and I believe if I were forty years younger I would almost give my right hand for the privilege of going with him.

He has been preceded by a great many eminent men, Englishmen, Americans and others. I was once talking to an old English Sea Captain, when he, looking at a map of the world, traced with his finger along to the Pole, and said, It can be done and England ought to do it. I still think that, as he said, it can be done. Although millions have been spent and hundreds of lives have been lost and although we cannot say whether very great results may be derived from the discovery of the Pole, the Captain's efforts ought to be seconded and Canada ought to help to pay the cost. If Captain Bernier is giving his own time, it is all that should be expected of him; and I do not believe there is a politician in the whole of Canada who would utter one word of complaint if the Government footed the whole bill. England has footed a great many bills to try to attain the same object, and I hope that Canada will assume the responsibility, at any rate she will do what she can to forward the scheme. When Captain Bernier returns, as I hope he will, whether successful or not, we will look upon him as one of the greatest explorers Canada has produced.

I have very much pleasure in seconding the motion calling for a vote of thanks. (Applause).

President Ross put the motion, and on a vote having been taken, declared it carried unanimously; and tendered the thanks of the Association to Captain Bernier for his very interesting and instructive lecture, and assured him that he had the hearty sympathy of the members of the Association.

Captain Bernier:—I feel highly honored at being permitted to give you my views upon the subject of the North Pole. I have made this question a study for twenty-three years, and if it is God's will I hope to reach the Pole. I will do my part to get there, and I have it in my inner soul that I can accomplish it.

I have heard some people remark, "Captain Bernier has been a master for thirty-one years, and he must be an old man now." Let me tell you, I am not an old man; I am not as old as I may look. I have been accustomed since my childhood days to outdoor exercise. As I look about me here to-day, I see a great many white heads, a great many men of over sixty years of age, but I see that these men are still full of vigor, and the reason for that is that they have always led active outdoor lives, as I have; and when a man has led an active life he does not rust and when he does not rust he will wear for a long time. I am the smallest member of my own family—all my relations are about six feet tall—and it might be said that as I am the smallest my heart must be small; but my blood runs quick because it has not got so far to go. (Laughter).

If any of you gentlemen have friends in Ottawa I would like you to tell them what you think of what you have heard me speak of to-day. But if you think I am going in the wrong direction, now is the time to say so; do not let me go, and after I come back, say, Well you did not go the right way. What I learn from you is for the benefit of Canada. Canada is a big place there is no doubt but there is room yet for thousands and those thousands are steadily coming all the time from mother England, Ireland, and from France and they are populating what I call, Big Canada. Now, we want to take this Pole before anybody else does; and I think it is time now for us to conquer that little bit of northern land and water which may hereafter be some good and may bring in some results for Canada.

I thank you most heartily for your kind reception and your sympathy.

President Ross:—I would like to hear the opinions of the members in regard to the Government assisting Captain Bernier; and I would like to have a motion in regard to that.

Mr. Chipman:—I would move, if I can get a seconder, that a Committee be appointed comprised of Mr. Tyrrell, who has explored the North of Hudson Bay, Mr. Stewart, who has been in the Yukon, and the mover, to draft a proper resolution approving of the scheme of Captain Bernier; such motion also to include a recommendation that the Government bear the expense of the expedition. As one who has studied this problem beside the grate fire in my library, on paper, I certainly feel that Captain Bernier is on the right track. Many years ago I stated before this Association that the proper route was exactly the one which is now mapped out by Captain Bernier.

Mr. Proudfoot:—I have much pleasure in seconding the motion.

The President put the motion, which was carried unanimously on a standing vote.

President Ross:—I have very much pleasure in announcing to you, Captain Bernier, that this motion is carried.

Captain Bernier:—I feel greatly honored; and when I go before Sir Wilfrid Laurier, I will be very glad to say the Surveyors of Ontario are in sympathy with me.

On motion, the meeting adjourned until Thursday, 28th February, at 10 o'clock a.m.

Morning Session.

Thursday, 28th February, 1901, 10 o'clock a.m.

The President called the meeting to order.

The President invited Captain Bernier to a seat on the platform.

Paper:—"Regulation of the Level of Lake Erie," by Mr. F. W. Farncomb, read by Mr. Tyrrell.

The President put the motion as follows: Moved by Mr. A. R. Davis, seconded by Mr. H. H. Gibson, that the thanks of the Association be presented to Mr. F. W. Farncomb for his paper and that the paper be published in the proceedings and on a vote having been taken, declared it carried.

President Ross here retired and Vice-President Dickson took the chair.

Paper:—" Topographic Photography," by Mr. J. N. Wallace; read by Mr. H. H. Gibson

Vice-President Dickson:—I am sorry there was not a larger attendance this morning while this paper was being read. It is a somewhat long and a very important one; photographic surveys are now taking a prominent place in our profession. I do not know much about photography myself, and I do not suppose I will ever learn. There is a great deal to be learned about it. One thing we do know is that a photograph is always correct. There is information in this report that is of great importance, not only to our profession, but to the legal profession, and to the public in general. The writer must have devoted a great deal of time and thought to it; I know from experience, that a man cannot sit down and write such a paper at a moment's notice. This paper should be published in full in our Minutes. I will be glad to hear any discussion on the matter.

Mr. Ford:—I would like to move a vote of thanks to Mr. Wallace for his paper and for the interest and trouble he has taken. Mr. Wallace is a personal friend of mine; and he has told me about the very arduous work he had out there. I am sure he took a great deal of time to write that paper. It is a matter that is of great interest to us.

Mr. C. A. Jones:—I have very much pleasure in seconding the motion.

Vice-President Dickson put the motion as follows:— Moved by Mr. Ford, seconded by Mr. C. A. Jones, that a cordial vote of thanks be tendered to Mr. Wallace for the very valuable paper which he has presented to this Association; and that the paper be printed in the Proceedings; and, on a vote having been taken, declared it carried.

Moved by Mr. Van Nostrand, seconded by Mr. H. H. Gibson, that the Report of the Topographical Survey Committee be taken as read, and printed in the Proceedings. Carried.

Moved by Mr. H. H. Gibson, seconded by Mr. Van Nostrand that the report of the Committee on Entertainment be taken as read and printed in the Proceedings. Carried.

On motion the meeting adjourned to meet at 2 o'clock p.m.

Afternoon Session.

Thursday, 28 February, 1901, 2 o'clock p.m.

President Ross called the meeting to order.

Mr. Dickson:—Before going on with the routine business of the meeting I have a resolution I would like to introduce. Yesterday, after listening to the very interesting lecture by Captain Bernier, it was the unanimous opinion of this Association that his scheme to reach the North Pole was a feasible one; that he had made thorough investigation and seemed to fully understand what he was doing, and was ready to offer himself up as a sacrifice on behalf of science. And this Association was of the opinion that as he was giving his time and his person we, as Canadians, should bear the expense; and a Committee was appointed to draft a resolution to that effect to be forwarded to Ottawa. That Committee has placed the resolution in my hands with letter attached and has asked me to move its adoption.

THE RIGHT HONORABLE SIR WILFRID LAURIER, G.C.M.G., P.C., OTTAWA.

Sir,—I have the honor to transmit to you herewith on instructions from the Association of the Ontario Land Surveyors the enclosed resolution, which was passed at the Annual Meeting of the Association held in Toronto on the 26th, 27th and 28th days of February, 1901.

This resolution was discussed and carried, after having heard Captain J. E. Bernier's description of his proposed undertaking and the methods he intends to employ in order to accomplish his purpose of reaching the North Pole.

The meeting was a very representative one of the Land Surveyors of Ontario, some of whom have already been beyond the limit of the Arctic Circle, and are therefore, in a position to form an opinion as to the necessities and difficulties of, and the advantages to be derived from, such an undertaking.

I have the honor to be, Sir,

Your obedient servant,

Villiers Sankey.

Secretary of the Association of Ontario Land Surveyors.

Moved by Mr. James Dickson, Vice-President of the Association; seconded by Mr. Willis Chipman, and resolved that:

"Whereas the Association of Ontario Land Surveyors has for many years made a study of Polar Explorations;

And the Committee of the Association on Polar Research engaged Lt. Peary to lecture before the Association in 1896, and in 1897 the Association instructed this Committee to attend Dr. Nansen's lecture, after his return from his "Farthest North";

And the expeditions of De Long, Nansen, Abruzzi, and others, have established beyond doubt the theory of the constant and regular drift of polar ice from Behring Strait across the Pole towards Iceland;

And several members of the Association have been engaged from time to time in exploring British America in the vicinity of the Arctic Circle;

And the Association holds that all portions of British North America should be fully explored and mapped, and all of our northern heritage claimed;

And the Association has heard Captain J. E. Bernier's lecture upon his projected voyage, and has heard his proposed equipment described;

And they believe Captain Bernier to be a suitable and capable person to command a Polar Expedition:

Therefore this Association at its Annual Meeting, hereby fully endorses Captain Bernier's proposed route to reach the vicinity of the North Pole *via* Behring Strait, thence north-westerly along the coast of Siberia until in longitude 170° east, thence northerly as far as practicable into the pack ice, thence drifting across the Arctic Sea in the direction of Iceland to navigable water; and believe Captain Bernier with proper support will succeed in his undertaking;

And the Association would respectfully urge upon the Dominion Government, the desirability of bearing all expenses in connection with fitting out the expedition and equipping the same;

And that a copy of this resolution be forwarded to the Premier of Canada."

This resolution was carried at the Annual Meeting of the Association of Ontario Land Surveyors, held in Toronto on February 26th, 27th and 28th, 1901.

VILLIERS SANKEY.
Secretary of the Association of Ontario Land Surveyors.

President Ross:—This resolution prepared by the Committee appointed at our meeting yesterday afternoon states the fact very clearly and properly and is very well drawn out. I take much pleasure in laying the resolution before you.

Mr. Tyrrell:—As a member of that Committee I might just state that we wished to embody in that resolution the fact that for years we have been not merely interested in a superficial way but we have taken a deep interest in this subject of Polar Ex-

ploration; and we have endeavored to put the resolution in a forcible way.

The President put the motion, and, on a vote having been taken, declared it carried.

President Ross:—Captain Bernier: I have very great pleasure in presenting you with a copy of this resolution which will be properly signed and sealed and a certified copy handed to you.

Captain Bernier:—Thank you, sir.

Mr. President, Vice-President and Gentlemen, I am very pleased to see that you have already made some start towards the North. This act of yours will be recorded in history. I have my life written down from the time I was twelve years old and to-day I am proud to say I will be able to register in my book that the Land Surveyors of Ontario have approved and further have declared that the proposed voyage to the Pole is by the proper route. With the help of God, we will reach there.

And this is for the benefit of Canada. When I was in England they said, Canada is a great place, a great country; if you can afford to send us 2,000 of your boys to help us in our difficulty surely you can send twelve or fourteen men to the North to explore and take what is your own land. I said, Gentlemen, I am one of them, and I am on the road. They said, if Canada will do something for you we will also be very pleased to give you some encouragement. Now, I am waiting for the Canadian Government to sanction it and for an appropriation, and then in England we will get some instruments or other things that we require for that voyage. Lord Strathcona was at my lecture, and he said he believed the climate would not keep any Canadian from going there; he said, The climate is such that when you get on the sea level of the polar basin it is nothing to compare with what we have in Winnipeg and Alaska.

I beg to thank you very heartily for your kindness to me, and I hope some day to come and tell you all about our voyage and our successes. As I said last night, I would feel very proud if one of the Surveyors of Ontario—one of the boys—would come along; and I am sure the application would be favorably considered and I would be proud to have one of the boys with me. (Continued applause).

President Ross:—I have here the report of the Committee appointed to draw up a suitable address of condolence to His Majesty the King.

To The King's Most Excellent Majesty

Most Gracious Sovereign,

The Association of Ontario Land Surveyors at its Annual Meeting held at the Parliament Buildings, Toronto, Canada, on February 28th, 1901, desires to place on record its deep sense of the loss sustained by the Empire in the death of

Her Most Gracious Majesty Queen Victoria

During her long reign her beneficent sway assisted to mould the various portions of the Empire into one harmonious whole, and all portions of the Empire mourn her loss.

Each member of the Association of Ontario Land Surveyors having, by virtue of his office, taken the oath of allegiance to the Sovereign, has felt and mourned her loss.

In renewing its allegiance to His Most Gracious Majesty King Edward the Seventh, the Association of Ontario Land Surveyors prays that his reign may be a long and happy one guided like that of his Illustrious Mother by Divine Providence.

William Saunby
Secretary

Geo. Ross
President

Moved by Mr. Dickson, seconded by Mr. Kirkpatrick, that the report of the Committee as read be received and adopted, and that a copy of the resolution be transmitted through the proper channel.

The President put the motion, and on a vote having been taken, declared it carried.

President Ross:—We will have a statement now from Mr. Stewart regarding the Report of the Exploration Committee.

Mr. Stewart:—I regret very much that my report is not quite in shape for reading. I did not know until last Saturday that I was chairman of this Committee; no doubt that was through my own fault; and since then I have not had time to get my report quite in shape, but I shall have it ready in a day or so, and place it in the Secretary's hands.

The Programme mentions a "Digest of Northern Ontario Explorations." The result of the explorations last summer has not yet been made public, so of course the report cannot give any results. In that respect, about all that can be given is a statement of what was intended to be done.

Moved by Mr. Proudfoot, seconded by Mr. Gibson, that the report be taken as read, and printed in the Minutes. Carried.

Mr. Kirkpatrick:—I would suggest that the Chairman insert a digest of it in time for printing; getting it as soon as it is published. He can prepare a digest of it, and it can come out in our Annual Report

President Ross:—Could you state when you would probably have this report ready, Mr. Stewart ?

Mr. Stewart:—It will depend now on when it is published. I suppose that in a week after it is published by the Department I could probably have my report ready.

President Ross:—We have on our programme a couple of items under the head of Discussion. One is on the "Duties of Surveyors as Referees," and the other is "Track Surveying." We would be glad to take up those discussions now. If we have present with us any member who will be kind enough to open up these subjects we will be glad to hear them.

We will first take up the discussion on The Duties of Surveyors as Referees. I understand that three of our members have had experience along this line; I refer to Mr. Kirkpatrick, Mr. Van Nostrand and Mr. McDowall. We will be glad to hear from Mr. McDowall.

Mr. Chipman:—I would like to know if any member can enlighten us as to the variation of the magnetic needle on the Siberian side of the North Polar Region. What is the magnetic variation ? Is it of such constancy and is there such force there as to produce a safe guide for navigators ? I am interested in this on account of Captain Bernier.

Captain Bernier:—On De Long's voyage he experienced from 18 to 23 degrees east, then, as he went north and west, it was decreasing. Then when we go back to Dr. Nansen, I find it was westerly increasing. From the time he left his ship to 86° .14′ there was a westerly deviation of 44° 4′, increasing going north, therefore I conclude that at the Pole there would be no less than about 55° westerly, because when running the curves over known points, when I come to join the points I find they would unite in Greenland. Between Greenland and Spitsbergen there is 35° and as we go to the westward it would increase again. So I expect when at the Pole the needle will be about 55° west.

Mr. Chipman:—I asked the question because one of our leading members to-day in discussing this question said that possibly another magnetic pole might be discovered on the Siberian Coast, and in the region between the two there would be no variation or there would be such variation as to prevent any navigation.

Captain Bernier:—I think there are only two magnetic poles, which are the negative and the positive.

President Ross:—There are some local poles.

Captain Bernier:—A local pole is a place where there is no disturbance. There is one in the South Sea after you pass the Cape of Good Hope, and there you will find there is no magnetic error; and on the coast of Siberia it is an easterly variation all along the Coast. If you read the voyage of De Long you will find the variation was decreasing as they went west.

I consider there would be a very large area where the needle will be about 180 degrees, in the neighborhood of 70 degrees north latitude.

Mr. Chipman:—I think the Committee on Repository and Biography should be stirred up. We find this year there is no biographical sketch, a very serious omission. I think each year a great effort should be made. The Committee is now two years old and surely in that time we should be able to secure the

portrait and biographical sketch of some of the earlier Surveyors General.

Mr. Van Nostrand:—This matter has received a very great deal of attention from the members of the Executive, and so far as the members that are in charge and responsible for that work are concerned everything has been done to secure biographical sketches and photographs of each of the few Surveyors General whose biographical sketch and picture has not appeared; but it has been impossible to find even representatives of those who are remaining. My recollection is that Mr. Wyatt, Mr. Cameron and one or two others whose names I have in a list here, have, so far as we are concerned, passed out of history. Further than that even if we could find representatives of Surveyors General their number is so small that they would only last us for a few years, and then what shall we do? What shall follow this practice of publishing a biographical sketch of a Surveyor-General each year? This question should receive attention now.

Mr. Chipman:—I think there are a great many able Surveyors who have passed away whose portraits we now have in our collection and as soon as we exhaust the Surveyors General we could commence publishing the portraits and biographical sketches of the early Surveyors.

Mr. Walker:—I think it would add very much to the interest of the proceedings to have a biographical sketch in the proceedings each year. If we run short of dead subjects why not give a few living ones? The Canadian Society of Civil Engineers publishes each year a portrait of its president. I think this is a very good thing indeed, then, as has been stated here, it is very difficult sometimes to get a good likeness of men after they have passed away, but we can always get good ones of those who are still with us. For my part, I do not see why we should wait until men are dead before we put their pictures in our proceedings.

Mr. Chipman:—Has any member of the Association volunteered to accompany Captain Bernier?

The President:—I think he stated to me that several members of the Association had volunteered; but I do not know positively. There is no doubt before the Captain completes his staff of assistants and sailors he will have several applications from our members.

Mr. Chipman:—I am sorry there are not more of our members here to-day. We should treat this matter more seriously, and should give Captain Bernier more assistance. It is a laudable enterprise and well-worthy of our support. We must not look at it from a monetary point of view, altogether, though if I were a younger and a more robust man, I would not hesitate at all to go, for I believe there is money in it. As I stated to the committee this morning I understand that Lieut. Peary cleared $40,000 one season after he returned. Many of us work a long time surveying before we do that. And Dr. Nansen has received over $100,000 on royalties on his books alone for one year.

The President:—I have, no doubt, some of our members, who appreciate this work, and the value of it, and the money that is in it, will volunteer to accompany the Captain.

Mr. Dickson:—I do not know that we can do any more in the matter than to recommend that some members of the Association should volunteer. One thing I do feel satisfied about, that either on the expedition, on the platform, or anywhere else, the Ontario Land Surveyor can hold his own; his writings are instructive and interesting, and his calculations are as accurate as they are interesting; this Association should ask some member to volunteer to accompany Captain Bernier.

Mr. H. H. Gibson:—When does he intend to start for the Pole ?

The President:—A year from next May, Captain Bernier desires to get one of our members who has had considerable experience in exploring on land in the Arctic regions. He is most anxious to have some member of this Association to accompany him. Before Dr. Nansen and Mr. Peary started, Mr. Chipman wrote to them and asked if they had an opening for one of our members.

Mr. Chipman:—Both were written to. Lieutenant Peary gave a definite answer. The volunteer, if I remember right, was requested to subscribe some hundreds of dollars towards the expedition.

Mr. Tyrrell:—No; Lieutenant Peary wrote asking the Association to have a member sent as a representative.

Mr. Chipman:—But when I wrote further, he said he was expected to contribute about $500 for the privilege of going—some hundreds of dollars.

Mr. Tyrrell:—There is no salary ?

Mr. Chipman:—No.

The President:—From what Captain Bernier told me, he expected a member of this Association going would have a salary equal to what he would have if he were working under the Department of the Interior.

Mr. Chipman:—If a member of the Association should volunteer, the Provincial Government might pay his salary while away? I do not think there would be any doubt about that.

The President:—Have you a resolution?

Mr. Chipman:—There is no need of a resolution. This matter should be brought before the members of the Association individually at an early day, before the proceedings are out: I think the Executive should take means to do so.

Mr. Tyrrell:—It would be well to have a small circular printed and sent to each member of the Association.

Mr. Chipman:—I will move that a circular respecting Captain Bernier's Polar Expedition be sent to all members at as early a date as possible, calling for volunteers to accompany the expedition, and at the same time outlining Captain Bernier's plan. This circular to include a copy of this resolution.

The President:—The Captain told me, he desired that any member volunteering should be approved by this Association as a body: or if no member of this Association would volunteer that we should select some one else, to represent us.

Mr. Tyrrell:—I have very much pleasure in seconding Mr. Chipman's motion.

The President put the motion and on a vote having been taken declared it carried.

Mr. Dickson: moved, seconded by Mr. Gibson, that the President, Mr. Ross, leave the chair and that Mr. Chipman take the same.

The Vice-President put the motion, and, on a vote having been taken, declared it carried.

The President left the chair, and Mr. Chipman took it.

Mr. Dickson:—I have much pleasure in moving that a cordial vote of thanks of this Association be given to Mr. Ross, our retiring President for the very gentlemanly and able manner in which he has presided over our deliberations.

Mr. C. A. Jones:—I have much pleasure in seconding that motion.

Mr. Chipman put the motion and on a vote having been taken, declared it carried.

Mr. Chipman tendered the vote of thanks to Mr. Ross, the retiring President.

Mr. Ross:—Gentlemen, I thank you most heartily. It has been a very great gratification to me to be President of this Association; and I consider it a very high honor conferred upon me. I was appointed Vice-President in the room of Mr. Foster, one of the greatest ornaments to the profession of Ontario Land Surveyors.

I think every member of this Association should aspire to hold this very high position. I am sure it would benefit any one to have that ambition. While I did hope to be President some day I was elected sooner than I expected to be.

I thank you gentlemen for the honor you have done me, the kindness and courtesy you have shown me and the good feeling that animated you in passing this resolution and tendering me the thanks of the Association. (Applause).

On motion of Mr. Dickson, seconded by Mr. Walker, the meeting adjourned, after singing the National Anthem.

PRESIDENT'S ADDRESS.

Gentlemen.—It gives me very much pleasure to have the honor of presiding at this, our first Annual Meeting in the new century, and welcome you to the sixteenth meeting of the Association, being the ninth, since the Act of Incorporation was passed. I am glad to note that the programme contains a good list of topics of interest to the majority of our members and, although there may not be so many papers to read, as on some previous occasions, there will be all the more time for discussion, and I have no doubt that this meeting will be a successful and profitable one.

It is gratifying to notice so good an attendance at the first session this year, as it augurs well for a full and regular attendance at all the sessions. There are at present 220 active members on the register, but only about one-fifth of our number usually attend the Annual Meetings, and an examination of the record shows that a very large percentage, if not the great majority, of the members never attend a meeting; never con-

tribute a paper, nor assist in the work of Committees. Since incorporation, the number of members attending the Annual Meeting has varied between 53 and 40; but the list of the names of members attending one year is very similar to a list of those attending any other year. A member attending one meeting usually looks forward with pleasure to the next, knowing that he is benefited by coming into contact and exchanging opinions with other members, and becomes a regular attendant and contributor. I do not suppose that any member prides himself on keeping aloof from our yearly gatherings, or in taking no part in the proceedings, or sighs for the old days in which there were no fees and no reports, therefore I venture to ask an additional number of members to become "active," in other respects than the mere payments of their fees. Members of our Association receive many benefits besides those conferred upon them by having legislation affecting their interests looked after, and unqualified intruders dealt with.

On the 22nd of January last, our beloved Queen died at Cowes, in the Isle of Wight, thus closing the longest and most illustrious reign of the world's greatest Empire. There are very few of our members who ever had, or can remember having any other sovereign; we have all taken the oath of allegiance to her, and can look back with pride and pleasure to having lived in the Victorian Era, in the reign of a queen who commanded the reverence and love of not only her own people, but the people of all lands. Her virtues and devotion have been a perpetual lesson and will remain an undying heritage. In the neighboring Republic, a land that once formed a part of the British realm, and that later fought against it in deadly strife, this granddaughter of George III. was mourned by rich and poor alike, and memorial services were held that were marked throughout by heartfelt sorrow. Thus she whose reign was crowded with victories, she who encouraged science, art, and literature, passes into history, followed by the affection of all the peoples of the earth." I recommend that a Committee be appointed to draw up and transmit through the proper channels, a suitable memorial showing the esteem and affection in which the Queen has always been held by the members of our Association, and the great loss her death has been to the Empire.

King Edward VII has commenced his reign, better qualified than any of his predecessors to fulfil the arduous duties devolving upon him, and will, without doubt, prove a worthy successor to his illustrious mother. As the Prince of Wales, he not only be-

came the most popular man in England, but won the esteem and affection of all, by his direct personal patronage of every charitable, beneficial, or scientific movement, and on taking the oath of accession, he said it would be his aim to work for the good and amelioration of his people.

I am sorry to have to announce that the hand of the reaper, death, has been at work among us during the past as on previous years, and has removed T. O. Bolger, (Kingston); D. B. Brown, (Cornwall); J. McCallum, (Fort Francis); J. M. Tiernan, (Tilbury Centre), and W. S. Davidson, (Sarnia). An extended reference to these members will be found in the obituary column.

It is with pleasure I note that the efforts of the Good Roads Association formed in 1894, is being crowned with success, and that many of the County Councils throughout the Province are taking steps to macadamize or permanently improve a network of main leading highways. This work is being fostered by the Government of Ontario, which will probably contribute one-third of the cost. If the condition of the roads is the measure of the character of a people, it is high time that the rural highways in this Province be put in a condition to reflect credit and not disgrace on an intelligent and progressive country. Many of our members will benefit by this improvement in at least being able to get back and forth from their operations in the field with greater ease and comfort, if not financially, in laying out and supervising the construction of the work.

During the past season several of our members have been engaged in exploring the northern part of this Province, and their reports will probably show vast tracts of mineral, timbered and agricultural lands. Extensive subdivision surveys may be looked for at an early date in this region, and when New Ontario is opened up by the projected railways, the hum of the pulp-mill, nickel and steel plants will be heard in the land.

The war in South Africa is now happily being brought to a successful close; a result to which Canada's sons contributed in no small measure. This war has shown to the world how firmly the bond of sympathy has been knit between the Mother Country and her colonies, and has also served to bring Canada and its resources prominently into the notice of Great Britain, which will no doubt be a means of stimulating the trade and commerce of this country.

I am happy to note that Canada is about to become prominent in Polar exploration, and that Captain Bernier, whom we have

present to-day, and who will address us on this subject to-morrow, has interested the Government of the Dominion in his proposed expedition to the North Pole, and is likely to set out with a suitable vessel, and the most modern equipment, at an early date. His work and progress will be watched with our hearty and active sympathy, and though he may not succeed where all others have failed, he will at least reflect honor and credit, not only on himself, but also on his country, and we hope he may have the supreme satisfaction of declaring the whole of the Pole as belonging to Canada by right of discovery.

GEO. ROSS,
President.

February 26th, 1901.

NOMINATION AND ELECTION OF OFFICERS.

The President called for nominations for the office of President for the ensuing year.

Mr. Kirkpatrick moved, seconded by Mr. Proudfoot, that Mr. James Dickson be president for the ensuing year.

There being no other nominations President Ross declared Mr. James Dickson duly elected President of the Association for the ensuing year.

President Ross called for nominations for the office of Vice-President.

Mr. Van Nostrand nominated Mr. W. R. Aylesworth of Belleville; seconded by Mr. C. A. Jones.

There being no other nominations the President declared Mr. W. R. Aylesworth of Belleville duly elected Vice-President for the current year.

President called for nominations for the office of Secretary-Treasurer.

Mr. Dickson nominated Mr. Villiers Sankey, of Toronto, for the office of Secretary-Treasurer; seconded by Mr. H. H. Gibson.

There being no other nominations the President declared Mr. Villiers Sankey duly elected Secretary-Treasurer for the current year.

The President called for nominations for the office of Auditor.

Mr. Walker nominated Mr. A. J. Van Nostrand, of Toronto, and Captain Gamble of Toronto, as the auditors; seconded by Mr. McDowall.

There being no other nominations, the President declared Messrs A. J. Van Nostrand and Captain Gamble duly elected as auditors for the current year.

The President called for nominations for members of Council.

The following nominations were handed in:

Mr. A. Lougheed, of Port Arthur, nominated by Mr. Proudfoot.

Mr. C. A. Jones, of Petrolea, nominated by Mr. Dickson.

Mr. John McAree, of Rat Portage, nominated by Mr. Van Nostrand.

Mr. C. J. Murphy, of Toronto, nominated by Mr. Kirkpatrick.

Mr. J. W. Tyrrell, of Hamilton, nominated by Mr. Walker.

The President appointed as scrutineers Messrs Esten and J. F. Whitson.

President Ross then introduced Mr. James Dickson, President elect, to the meeting.

Mr. Dickson:—Gentlemen: I thank you very kindly for the very high honor you have done me in electing me your President. I have been a member of the Council for one year, and Vice President during the past year, and during my connection with the Association as a member of the Committee and as an officer I have always been able to say that every member of the Association has given his most hearty co-operation and assistance to the office-bearers, and I feel sure that I can count on your assistance in the future as the other officers have in the past, and I know that you will do all in your power to aid me in the proper discharge of the duties of my office as President of the Ontario Land Surveyors' Association for the year 1901-2.

It was moved by Mr. Dickson, seconded by Mr. Walker, that the Secretary-treasurer be paid the sum of $225 as a slight mark of appreciation on the part of the Association for his services as Secretary-treasurer last year. Carried.

Moved by Mr. Kirkpatrick, seconded by Mr. Dickson, that the Association has heard with deep regret of the loss by death of the following members of the profession since the last Annual Meeting of the Association: Walter Stanley Davidson, Joseph Martin Tiernan, Thomas O. Bolger and David Rose Brown and that a copy of this resolution be forwarded to each of the respective families of the deceased members. Carried.

Moved by Mr. H. H. Gibson, seconded by Mr. C. A. Jones, that any omissions or clerical errors in the records of this meeting now in the hands of the acting secretary and stenographer be corrected by the committee on publication before being printed. Carried.

Moved by Mr. Tyrrell, seconded by Mr. Walker, that a Committee on Polar Research be appointed by the Council. Carried.

Moved by Mr. Walker, seconded by Mr. Robertson, that a fee of $5 be paid each of the auditors on completing their work of auditing the accounts of the past year. Carried.

Moved by Mr. Van Nostrand, seconded by Mr. H. H. Gibson, that the Council of Management be instructed to take up the question of the preparation of papers for the programme for the next Annual Meeting, and that this shall be a matter in which the Council has full responsibility, and that the members thereof be instructed and requested to see that the papers are forthcoming as required. Carried. Mr. Walker asked for information in regard to a paper by Mr. Wicksteed on Railway Work, which was ordered to be published in the proceedings of last year, but which does not appear.

Mr. Van Nostrand stated that the publication of the paper was authorized by the meeting; that the paper was taken as read, and directed to be printed in the proceedings, but the paper was not forwarded, and therefore could not be printed.

NOTE.

The following letters have been received from Ottawa in response to the Address of Condolence sent to His Majesty the King, which is given in fac-simile on page 29.

B

SECRETARY OF STATE, CANADA.

File No. 186.

Ottawa, 11th May, 1901.

Sir,

I have the honour to acknowledge the receipt of your letter of the 10th instant, advising of the transmission of a copy of a resolution passed by the Association of Ontario Land Surveyors, expressing condolence on the occasion of the death of Her late Majesty Queen Victoria, and praying that the reign of His Majesty King Edward the Seventh may be a long and happy one, and to state that the same has been forwarded through the proper channel to the end that it may be laid at the foot of the Throne.

I have the honour to be,

Sir,

Your obedient servant,

Joseph Pope.

Under-Secretary of State.

Villiers Sankey, Esq.,
Secretary-Treasurer,
The Association of Ontario Land Surveyors,
City Hall, Toronto, Ontario.

SECRETARY OF STATE, CANADA.

W.

No. 186. *Ottawa,* 11th July, 1901.

Sir,

Following up a letter from this Department, dated the 11th of May last, I have the honour, by command of His Excellency the Governor-General, to convey to you, and through you to the members of the Association of Ontario Land Surveyors the grateful thanks of His Majesty The King for the sympathetic and loyal message forwarded with your letter of the 10th of May, 1901.

I have the honour to be,

Sir,

Your obedient servant,

P. Pelletier,

Acting-Under-Secretary of State

Villiers Sankey, Esq.,

Secretary-Treasurer,

Association of Ontario Land Surveyors,

City Hall, Toronto.

MEMBERS IN ATTENDANCE AT THE NINTH ANNUAL MEETING.

FEBRUARY 26TH, 27TH AND 28TH, 1901.

Geo. B. Abrey.
W. R. Aylsworth.
E. G. Barrow.
David Beatty.
C. D. Bowman.
H. J. Bowman.
W. A. Browne.
M. J. Butler.
Willis Chipman.
Allan Ross Davis.
John Alton Davis.
James Dickson.
H. L. Esten.
J. D. Evans.
R. P. Fairbairn.
W. B. Ford.
K. Gamble.
J. Hutcheon.
C. A. Jones.
G. B. Kirkpatrick.
R. McDowall.
H. McGrandle.
W. A. McLean.
C. J. Murphy.
H. B. Proudfoot.
V. M. Roberts.
James Robertson.
George Ross.
V. Sankey.
H. DeQ. Sewell.
W. V. Taylor.
J. W. Tyrrell.
A. J. VanNostrand.
A. P. Walker.
J. W. Warren.
J. F. Whitson.
Wm. Spry.
L. B. Stewart.

RESULT OF ELECTIONS FOR 1901-1902.

President.....James Dickson.....(by acclamation).
Vice-President.....W. R. Aylsworth.....(by acclamation).
Secretary-Treasurer.....Villiers Sankey.....(by acclamation).

Members of the Council of Management elected for the ensuing three years:

J. W. Tyrrell. John McAree.

Auditors for the ensuing year: (by acclamation).

Capt. Gamble. A. J. Van Nostrand.

I declare the above named officers elected.

VILLIERS SANKEY,
Secretary-Treasurer.

Certified correct.

J. F. WHITSON,
H. L. ESTEN, } *Scrutineers of Ballots.*

Under sec. 11 Chap. 179, R.S.O. 1897, the Council appointed Mr. C. A. Jones to fill the vacancy caused by the resignation of Mr. W. R. Aylsworth as member of the Council.—*Secretary.*

REPORT OF THE COUNCIL OF MANAGEMENT FOR THE YEAR 1900.

The Council during the year held its regular meetings as prescribed by the Statutes.

Mr. James Dickson having been appointed vice-president on the death of the late F. L. Foster, the Council, under Section 16 of the Act Respecting Land Surveyors, appointed John McAree, of Rat Portage, as member of the Council.

Messrs. B. J. Saunders and Maurice Gaviller were reappointed members of the Board of Examiners, their terms of office having expired. Mr. M. J. Butler's term of office, to which he was nominated by the Lieutenant Governor in Council, has just expired.

No By-laws were passed during the present year.

Progress has been made towards supplying a reliable Standard for Surveyors. The Secretary-Treasurer has been in correspondence with a firm and will bring the subject before the Association in a separate paper. Meanwhile it may be satisfactory to state to the Association that the Standard Bar in the custody of the Secretary of the Board of Examiners made by Messrs. Troughton and Simms, is probably the most reliable Standard in the Province to-day, it having been compared with the Standard in Great Britain, and also having been compared with the Standard in Ottawa, and its exact value given in an indenture, under the hand of the Commissioner of Standards at Ottawa.

As regards unlicensed practitioners, the Council has had under consideration, letters from several Surveyors and it has taken action on one and placed the matter in the hands of a legal firm for prosecution. This is a case in which it appears there ought to be no difficulty in obtaining a judgment, and it has been thought better to defer the others until this case has been decided.

Respectfully submitted,
GEO. B. KIRKPATRICK,
Chairman of Council.

Toronto, February 27th, 1901.

DISCUSSION.

Mr. Kirkpatrick:—The case referred to is one relating to an unlicensed practitioner. The Council of Management has in-

structed a firm of lawyers to take the matter up and prosecute him; and we are advised that we have a very good case.

Mr. Sankey:—The man referred to is named Poitvin, down east of Ottawa. The case is in the hands of a very well-known firm of lawyers in Ottawa, and I had a letter from them yesterday morning saying they have six instances in which the man has run lines and been paid for them. They feel perfectly convinced they can convict him. This is not the first time his name has been reported to the Association; he has been going on with this work for a long time, but he has always evaded the service of papers on him. But Mr. Lewis has taken the matter up and made personal efforts to find the exact details of what the man complained of has been doing. While in Ottawa I intend to see how far our solicitors have gone, and to urge them to go on with the case because there is no question we have a case now worth while taking up. The difficulty before was that Mr. Lewis and some others seemed to think the local Surveyors should be the prosecutors, and the local men did not wish to take that position. The moment I learned that was their difficulty I informed them that the Registrar of the Association was the proper person to take up the prosecution, and that the prosecution should be made in the name of the Association. A prosecution in the name of the Association would be much more effective than if it were in the name of an individual surveyor.

There is another case reported at Powassan, but we thought it would be advisable to wait till the result of the other prosecution became known and possibly then, having secured one conviction, the other one could more easily be effected.

REPORT OF THE BOARD OF EXAMINERS.

The following is the report of the Board of Examiners:

The Board of Examiners met at the office of the Hon. the Commissioner of Crown Lands, on Monday, February 11th, and the following days, as provided by statute. The following candidates passed the required examinations:

FINAL:

Jackson, James Herbert, city of Windsor.

PRELIMINARY:

Adams, Charles F., city of Brantford.
Code, Richard Stanley, Alvinston.
Greenlees, Alexander Hunter, city of London.
Brian, Michael Edward, city of Windsor.
Clark, Charles B., London township.

Bonds of the following Land Surveyors were approved and filed, in accordance with the provisions of the Act:

MacPherson, Charles Wilfrid.
McNaughton, Finlay Donald.
Stull, William Walter.
Fairchild, William Howard.
Shaw, John Henry.
Weeks, Melville Bell.

The following Articles were filed by the undernamed pupils with the undernamed masters:

NAME OF PUPIL.	NAME OF SURVEYOR.	RESIDENCE.	DATE OF ARTICLES.	TERMS.
Clark, L. O.....	Farncourt, F. W. ..	London, Ont. ..	Feb. 16, 1900	Three yrs.
MacCallum, A. J. ..	Robinson, T. J.....	Barrie, Ont....	May 15, 1900	One year.
Russel, W. B.....	Shaw, J. H.	North Bay, Ont.	June 25, 1900	One year
Holcroft, H. S.	Speight & Van Nostrand	Toronto, Ont...	May 17, 1900	One year.
Law, E. H.	DeMorest & Sylvester	Sudbury, Ont..	Jan. 17, 1900	One year.
Bray, L. T.	Bowmay, H. J.....	Berlin, Ont....	Sept. 1, 1900	One year.
Anderson, W. B....	Wilde, J. A.	Sault Ste. Marie	Nov. 24, 1900	One year.

In the case of Mr. Holcroft, the Board of Examiners, under the provisions of Sec. 29, R.S.O.C. 180, allowed him to make a break in his term of service, in order to take a post-graduate course at the School of Practical Science.

Respectfully submitted,

GEORGE B. KIRKPATRICK.
Chairman of Board.

Toronto, February 27, 1901.

Moved by Mr. Kirkpatrick, seconded by Mr. Dickson, that the report be received and adopted. Carried.

SECRETARY-TREASURER'S REPORT.

DISCUSSION.

Mr. Dickson moved, seconded by Mr. John Davis, that Mr. Van Nostrand be appointed as auditor in the place of Mr. H. J. Browne. Carried.

Mr. Sankey:—The general tenor of the report is almost identical with that of last year; so many fees paid and the accounts have all been passed by the Council. It is simply a matter of putting the accounts into a list. There has been no extra expense this year except the publication of the Manual, which cost us about $180 for printing and binding. As you will remember, the Manual was distributed early in the season. The expenses of the Council have been about the same as last year; and the expense of the Board of Examiners something less than last year. The fees are practically paid up as well this year as they were last year, but some few members are in arrears for several years. However, other members who had been seriously in arrears have been able to send their money in. Taking one thing with another we are in about the same position as last year.

Mr. Gibson:—How does the balance stand now ?

Mr. Sankey:—Roughly speaking, two or three hundred dollars to the credit of the current account.

President Ross:—And what is the amount in the Savings Bank ?

Mr. Sankey:—We had to draw from the Savings Bank in the early part of the year to pay for the Manual; and, you may remember, there was a grant made to the patriotic fund last year which took the cash out of the treasury in the early part of the year. But now, the fees in the last three or four months have been coming in most satisfactorily, and in cases which I really despaired of I have been very pleased to get bank drafts for a considerable amount of money from certain members who find it is in their interest to be paid-up members of the Association.

Mr. John Davis:—I would like to ask why it is that the report of our Proceedings is so long in appearing. I notice it is in the neighborhood of Christmas before we get the report, and that seems to me to be an extraordinarily long time for the printing of a document like ours. Perhaps there is some reason.

Mr. Sankey:—The difficulty we experienced this year was largely due to the long time it took to get the proofs of some of the papers corrected by the gentlemen who contributed the papers. Some of the papers had to be sent to the men who wrote them but who were not present at the meeting, and it took them a long time to send them back to us. One of the papers had to be recast before being printed. And the printers delayed me five or six weeks; I did not get the reports from them till October; and then we commenced sending them out. I know a great many were posted in October and November and some gentlemen here to-day say they have not yet got them. This was to me the first intimation that they had not been received by those to whom they were sent. The only way I can account for it is that the wrappers were torn off. I am informed that in the Hamilton Post Office several were found without the wrapper on, although I had used the same wrapper as has been used heretofore. I do not know whether that was because of the rougher handling they received; but to provide against the possibility of that I have now adopted a heavier wrapper. Being new to the business I did not know how close

one has to watch printers, and authors of papers and everything else in order to get the thing out in proper shape. Another year it will not take me so long.

While speaking on this matter I would say that it is only in the last three weeks I have received any more of our exchanges from the States. In fact three of them came during the week of the meeting of our Board of Examiners, and they are up now in our Repository ready for mailing. The people on the other side of the Line, with whom we exchange, seem to have had the same kind of delay we have had.

President Ross instructed the Secretary, Mr. Sankey, to send his report on to the Chairman of the Council.

REPORT OF COMMITTEE ON REPOSITORY AND BIOGRAPHY.

Mr. President.—Your Committee on Repository and Biography, beg leave to report as follows:—

As foreshadowed in the report of this committee for the preceding year, the change of rooms for the use of the Board of Examiners and the Association has been made, and the great improvement in our accommodation is too evident to require notice, further than as recognition of the generous treatment we have received at the hands of the Honorable, the Commissioner of Public Works. In addition to the advantages for the purpose of meeting, the three rooms now under our control are available for committee meetings, and for the use of individual members, who have occasion to copy plans, etc., of record in the Department of Crown Lands.

It is expected that during the coming year, further improvement will be made in this direction.

A considerable number of additions have been made to the number of works in the library, and a new catalogue will shortly be required.

The Biographical section of the committee has now more or less complete sketches of the following Surveyors:

Mahlon Burwell, Milton C. Schofield, John Farquharson, Richard Birdsall, E. C. Caddy, Aaron Greely, D. O'Reilly, Samuel Ryckman, Peter Carroll, John S. Aylesworth, J. D. McNabb, P. N. Hyndman, William Robinson, Samuel S. Willmott, J. Nepean Molesworth,, David Gibson, John A. Tidy, Thos. W. Walsh, Eliakim Malcolm, Jas. Kirkpatrick, Augustus Jones, John McDonald, J. Stoughton Dennis, William Campbell, Henry Strange, Thos. A. Blythe, Hugh McMahon, John Stigman, Robert Synee, Charles Rankin, T. C. Keefer, E De Cew, Hugh Black, Henry Ewing, S. M. Burson, J. M. O. Cromwell, Hon. A. Yidal, H. DeQ. Sewell, Francis Bolger, C. J. Wheelock, Jos. Kirk.

Some of these sketches are complete, whilst others are mere outlines. It has been suggested that with the above list in printed form, additions may be made by members who can recall incidents in the lives of many of those enumerated, and thus add to the collection of data.

An interesting collection of photographs has been begun, and your Committee would take this opportunity to solicit contributions of biographical sketches and photographs of members who have not already accepted previous similar invitations.

Respectfully submitted,

A. J. VAN NOSTRAND.

Chairman.

REPORT OF PUBLICATION COMMITTEE.

MR. PRESIDENT,—Although your Committee commenced their labors soon after the Annual Meeting, our Report was not published as soon as we expected. There was considerable delay in the correction of the "proofs" of some of the "papers," as the whereabouts of the authors was difficult to obtain; and a good deal of time was taken up in redrafting nearly all the illustrations.

We were unable to obtain a suitable biographical sketch for publication.

1,350 copies of the report were satisfactorily printed by Messrs. Henderson & Co., at a cost of $374.42.

We desire to call the attention of the members of the Association to our advertisements.

We exchanged Reports with the following Societies:

School of Practical Science Engineering Society	150
Michigan Engineering Society	125
Ohio Society of Surveyors and Civil Engineers	125
Illinois Society of Engineers and Surveyors	135
Indiana Engineering Society	100
Iowa Civil Engineers' and Surveyors' Society	85
Wisconsin Engineering Society	
Purdue Society of Civil Engineers	

Respectfully submitted,

KILLALY GAMBLE

Chairman.

February 27th, 1901.

REPORT OF THE COMMITTEE ON LAND SURVEYING.

Mr. President,—Your Committee on Surveying have nothing special to report this year.

Six papers, containing questions, have been under the consideration of the Committee, and they beg to submit the following conclusions: for your examination and adoption or amendment.

Your Committee also considered Mr. John McAree's communication on the subject of an "Ontario Manual of Surveys," and beg to recommend that the same be referred to the Council with a request that the Council will take action thereon, and have Mr. McAree's ideas carried out if possible.

All of which is respectfully submitted,

Wm. R. Aylsworth

Chairman.

Feb. 27, 1901.

QUESTION DRAWER.

Ottawa, February 21st, 1901.

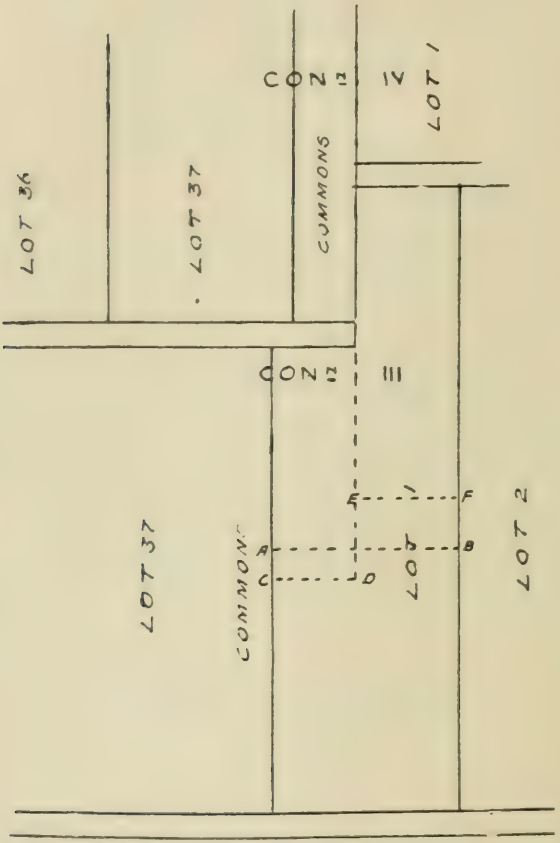
Mr. V. Sankey:—

Dear Sir,—I regret to say that I shall be unable to attend the O. L. S., annual meeting next week but I enclose a question which came up in my practice a couple of months ago. I would like to have the answer of the Surveying Committee at as early a date as possible, and would consider it a favor if you will attend to it for me.

Thanking you in anticipation,

I am yours very truly,

A. J. McPherson.



The above diagram shows the boundaries of Lot I in the 3rd Con., of a single front concession Township in Ontario.

How would the dividing line between the north and south halves be run ?

Would it be as shown at A B, or C D E F, C and F being the middle points of the side-lines of the lot ?

Ans.—Draw line A B on a mean course between the north and south ends of the lot so as to divide the lot into two equal parts.

Eganville, February 23rd, 1901.

W. R. Aylesworth, Esq., O. L. S.,
Chairman Committee on Question Drawer.

Dear Sir,—I enclose Sketch of part of Township of Brougham, surveyed 1871, Sectional system.

On the ground I found line between lots 15 and 16, where it was intersected by line between Concession III and IV, I traced both lines for a considerable distance, but found that instead of it being seven chains on concession line, and two chains on side-line from roads to water as shown in Field Notes, the distances on ground were about 14 chains and 8½ chains re-

spectively. From Field Notes it is doubtful whether posts were planted on south side of Whitefish Lake, though the inference is they were, and one old settler says he saw one of them, *i.e.*, between 16 and 17. I want to know how you would proceed to run lines between lots 16 to

20 inclusive and to establish blind line between concessions II and III in this block. The old posts at intersections of Road allowances between concessions III and IV, lots 25 and 26 are standing; no other posts can be found between these and intersection of concession with line between 15 and 16. I found width of lots 16, 17, 18, 19, 20, 21, 22, 23, 24 and 25 to be 200 chains .04 links, instead of 204 chains .60 links, as shown by Field Notes.

There is not any allowance for road around Whitefish Lake.

Trusting that this is not too late to receive attention of your committee, I remain,

Yours truly,

HERBERT J. BEATTY.

ANS.—1. Connect points or posts that can be found on concession-line, 3rd and 4th concessions east and west of Whitefish Lake by a straight line; and points on side-road line 20 and 21, south and north of Lake by another straight line, measure distance from intersection of said lines to line of side-road 15 and 16, deduct half width of side-road and divide remainder of distance proportionally into five lots:

2. Divide distance from said intersection on line 20 and 21, to line 1st and 2nd concessions equally, also divide length of 2nd and 3rd concessions on line 15 and 16 equally, and then draw straight line between these middle points from rear of 2nd concession lots.

NO. 3.

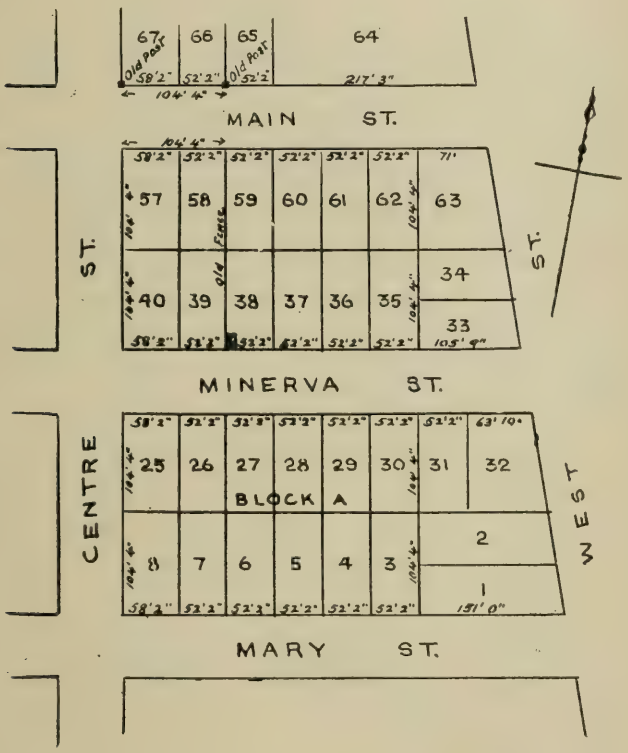
Huntsville, Ont., February 5th, 1901.

The accompanying plan shows part of the Town of Huntsville, surveyed in June 1876 and plan registered on the 22nd August of same year. The said plan shows the lots adjoining the east side of Centre Street to have a frontage of 58 feet 2 inches, and all the other full lots a frontage of 52 feet 2 inches. There is an old post between lots 65 and 66, an old fence between lots 58 and 59, and there was a stable erected in August 1876, on the south-west corner of lot 38, leaving a distance of 104 feet 4 inches between each of said land-marks and the east

limit of Centre Street. How should the lines between lots 39 and 40, lots 57 and 58, and lots 66 and 67 be established ?

How should lines between lots in Block A be established ? No old land-marks being found.

HUGH MCGRANDLE.



ANS.—1. Give each lot 66 and 67, its proportion according to Field Notes of whole width on ground of both lots.

2. Find point on south side of Main Street between lots 58 and 59 from original post 65 and 66 on north side of Main Street, and give 58 and 57 each its proportion of width on ground. (Vide. section 37 and sub-section 2).

3. The old stable without further evidence is not sufficient to establish that corner.

4. The boundaries of Block A. must be first fixed and then the block divided according to the original Field Notes or plan.

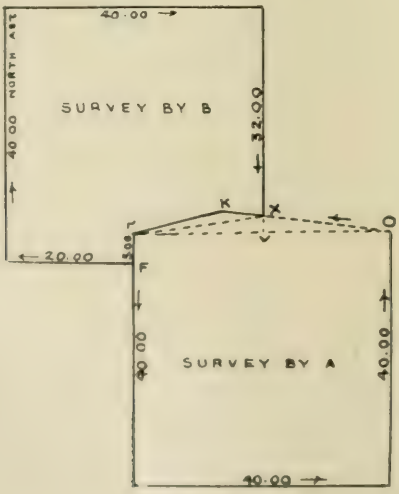
For answer to your next question with diagram, see answer to Question 2 above.

No. 4.

LAND SURVEYING, MIXING LOCATIONS.

In a bush survey, Surveyor A. in order to hit the post exactly, when closing along his northern boundary, turns off an angle at K. from which point the post probably first became visible.

Surveyor B. on a subsequent adjacent survey begins at F, and in closing to the south on his eastern boundary is startled to find a cut line at X. Should Surveyor B stop at X and go round via. K to P. or locate Y on the alignment OP and cut the line from Y to P? If the former, should he not plant a post at K also? In any event if a fire should obliterate all the lines, leaving only the pyramids of stones at the corners, would not O—P be the N boundary of A's survey? If a corner be placed at X, then possibly O X P would be the final result?

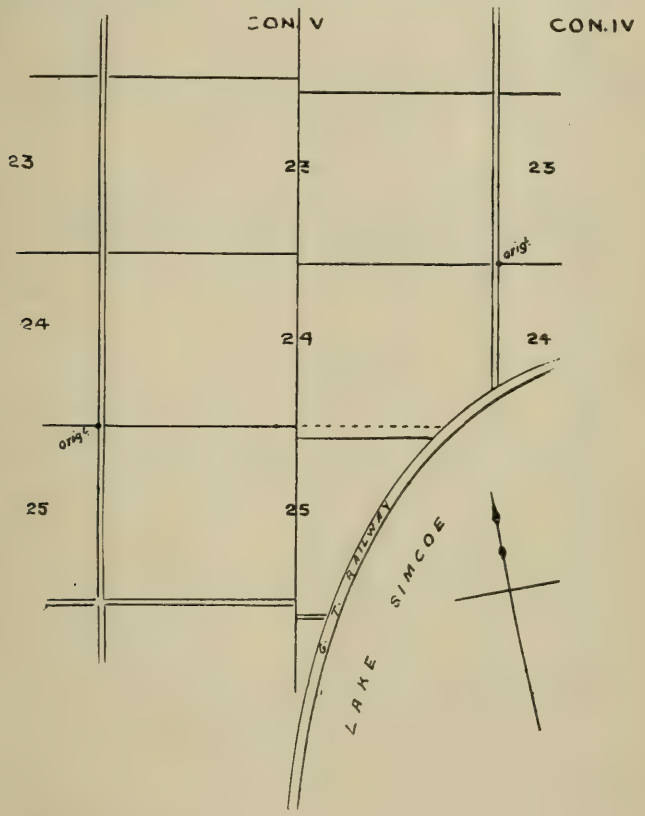


ANS.—More data is required for complete answer: but if Surveyor A ran the line O K P and it can be proven that he did so we think it must stand.

Collingwood, August 21st, 1900.

P. S. Gibson, Esq., O. L. S., Willowdale, Ont.

Dear Mr. Gibson,—I have a question of boundary on hand, on which I would like to get your opinion, as I have not got the dates of the old amendments to the Survey Act.



The case is as follows:

In 1838 the boundary between the east halves of lots 24 and 25, concession V (see diagram enclosed), was fixed giving a jog on the blind line of concession V.

This survey was confirmed by H. P. Savigny, P. L. S., in 1854, and it appears also by Gibbard and Robt. Ross, P. L. S's. In 1872 or 3, when determining titles for the Muskoka Extension Railway, P. L. S., A. C. Thompson, in conformity with Section

31 Survey Act, ran a line from the post in *Rear* straight through to the lake leaving no jogs.

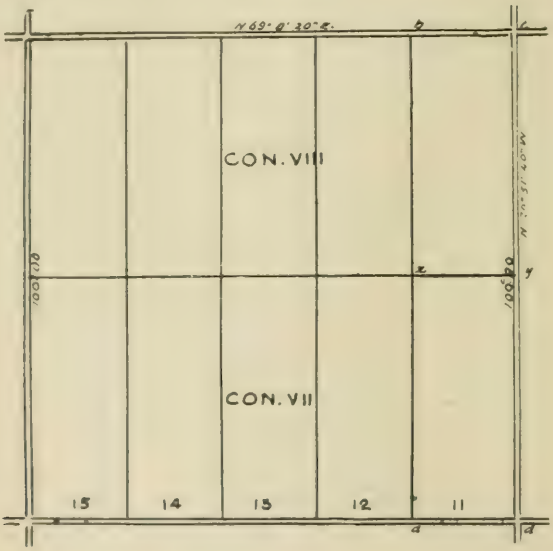
Qr.—Was there anything to permit the first survey giving jog in the centre of the concession ?

We want the matter settled without law-suit.

Yours sincerely,

M. GAVILLER.

Ans.—Line should be run from rear of 5th concession straight to the lake. (See last part of Section 31).



No. 6.

Sudbury, Ont., January 22nd, 1901.

W. R. Aylesworth, Esq., O. L. S., Belleville,

Chairman L. S. Committee, O. L. S. Association.

Dear Sir,—I herewith submit a question for discussion by your Committee.

How would you run the rear line of any or of all the lots in this block ?

This is in a Township mentioned in (Sec. 28, sub. 2), wherein it is enacted that all lines must be run on the astronomic bearing as shown in original Field Notes.

It has been my practice so far to run rear lines on a course to intersect side lines of lots in the middle, presuming that Sec. 28 (2) only refers to side lines of lots, but I do not see that the section covers this.

Yours truly,

L. V. Rorke.

Ans.—We think Sec. 28, S.S. 2, only refers to side-lines of lots—and rear line of lot No. 11 in 7th concession, should be run, if original Field Notes show that to have been the intention, from middle point on c. d, to middle point on a. b. (Vide Sec. 34).

REPORT OF COMMITTEE ON DRAINAGE.

Mr. C. A. Jones:—Mr. President, and Members of the Association, Mr. Code, the Chairman of the Committee on drainage, is not present to-day, and in his absence the Secretary has asked me to read the report.

Mr. C. A. Jones reads the report as follows:—

TO THE ASSOCIATION OF ONTARIO LAND SURVEYORS:

Gentlemen,—That the work of drainage has not diminished during the past year, and that litigation has not decreased, appears to be the conclusion of a number of members of this profession, whose practice is composed largely of drainage work.

It would involve considerable labor to review the drainage works of importance and decisions respecting drainage cases, and it has been before suggested that the reports and decisions on drainage cases might be published at nominal expense, by the Provincial Government, in which suggestion many concur.

The provisions of The Drainage Act are being gradually defined by decisions of the courts, but the enormous cost of such, suggests that some change should be made in the procedure, upon which final decisions are given.

The main questions as to usual, "Benefit," "Outlet Liability," and "Injuring Liability,"—and of note among opinions expressed in cases decided in the past year is contained in "Notes for Judgment of the Court, delivered by Gwynne, J., *re* Sutherland Innis Co., v. Romney," an appeal from a judgment of the Court of Appeal, of Ontario, affirming a judgment of the High Court, dismissing an action instituted by the appellants, in which the learned Justice states:

. . . . . "Then in Sec. 3, sub-section 5, is enacted, the mode by which the amount to be charged to each particular lot to be assessed is to be determined.

A careful consideration of the Act therefore condemns, in my judgment, as wholly inadmissible, a construction which should hold that lands not benefited by a drainage work constructed under the provisions of the Act, are nevertheless made liable to assessment, for "Injuring Liability,' or "Outlet Liability,"—notwithstanding the words in the third section, purporting to authorize the Engineer, to make an assessment of the lands and roads within said area, to be benefited, and of any other lands and roads liable to assessment as hereinafter provided. The provisions coming under the term "as hereinafter provided," seem, I think, to favor rather the construction that what the Legislature intended was, to provide in the interest of the persons to be assessed, that the sums should shew the nature of each item charged separately, as follows:—First, for "Benefit," meaning I apprehend thereby, (for no interpretation is given to this word in the Act), the benefit conferred by the facility for the drainage of all lands within the area of the drainage work; which benefit would vary according to the difference of elevation of the respective lots:—the quantity of water to be drained from each; the distance of the several lots from the drainage work, and the like.

Secondly:—For "Injuring Liability," that is to say for the special charge to each lot from which water is caused to flow to the injury of other lands in the manner described in the Act, under definition of "Injuring Liability." The whole cost of that work, in so far as it relates to the removal of this water is to be borne specially by an assessment upon the lots for which the water doing injury is so caused to flow.

Thirdly:—For "Outlet Liability," which is only authorized to be assessed for in the one particular case of a drain constructed in one Township being continued into another until a sufficient outlet for the waters coming down such drain is reached.

The application of the same precise mode for determining the amounts chargeable for "Injuring Liability" and for "Outlet Liability,"—does not appear to be, I think, quite felicitous. The best mode of applying that sub-section to "Outlet Liability" would seem to be, first—to determine the total amount chargeable for "Outlet Liability," by a calculation based upon the volume in which, and the speed at which the water comes down the drain to its outlet in another Municipality, than that in which the drain is initiated, and secondly; to apportion that sum among the several lots from which the water is caused to flow by artificial means from the lands assessable into the drains upon a calculation, based upon the volume in which, and the speed at which such waters are respectively so caused to flow into the drain. In any case all lands from which no water is so caused to flow into a drain, having its outlet in another Municipality than that which the drain was initiated, would be exempt from assessment."

To compile a report to agree with the enactment of the Drainage Act, with the various interpretations placed upon such by the different courts is a work requiring considerable ability and the necessity of a personal inspection of each particular parcel is apparent from decisions on appeals to the Drainage Referee, and the Higher Courts.

Work under the Ditches and Watercourses Act is apparently in no better condition than formerly to judge from the opinions expressed by members.

Some time ago, Sec., 28 of this Act, relating to the non-completion of work was amended by inserting the clause, "or at any time, not later than six months after the time fixed for the completion of the ditch."

The working of the entire Act is blocked by this insertion, after the time limited has expired, and the Engineer has no authority to let the uncompleted parts, and the only course clear is a new award with its attendant risks.

An extension of time should be made, or the clause omitted entirely.

Though it is evident, we will not see changes effected until

after extensive litigation, it is still wise to work under Acts as they are, and to follow carefully the decisions of the courts relating to the various sections.

A. S. CODE,
Chairman of Committee on Drainage.

February, 27th, 1901.

DISCUSSION.

Mr. Sankey:—The case referred to in that report is the Sutherland Innis Company, plaintiffs, against the Township of Romney, and is reported in volume 30 of the Supreme Court of Canada Reports; this was an appeal from the Court of Appeal of Ontario. The report of the judgment commences at page 495 and concludes at page 535.

Mr. Jones:—Mr. Sankey has suggested having a number of copies of this report struck off in typewriting and sent to those who are most interested in drainage matters and ask them to send in their opinions or suggestions in regard to it.

Mr. Aylesworth:—I think if the case were cited in the Committee's report that those interested could get access to the law libraries and see the report as it is published in the Official Court Reports.

Mr. Sankey:—I was going to suggest getting five or six typewritten copies, which would not be a very expensive matter, and they could be forwarded in the form of a circular letter to those members of our Association who are more intimately connected with drainage, and each one asked to send in a small digest of his ideas, and to say whether in his opinion it would be interesting to the members at large to have this printed or to have a digest of it in our annual report. Of course the case would be cited any way; but possibly it might be difficult for some members to get hold of these Supreme Court Reports; in the large towns and cities they could be got at, but in the country it would be more difficult. I think it would be a little work for the new Drainage Committee to tackle in the early stages of their year if they were to give us a digest on the matter for publication in our next annual report.

The President:—It would not cost much more to print the whole report in full, than to make typewritten copies, and if printed in full it could be sent out to all our members.

Mr. Sankey:—Several members are not interested in drainage at all. If we sent it to the drainage men, those most interested, six copies would go a long way; and if they would send us a digest on the result, I think we would get up a very useful addition to our next year's proceedings.

The President:—Almost every member is liable to have drainage cases.

Mr. Sankey:—Just printing that without any remarks would not be of as much use as if we had the opinions of men qualified to give opinions on the matter, and then publish the whole thing together. Still, if the Association desires to publish the whole of it, the expense does not amount to a great deal, and a matter of expense should not deter us from doing it.

Mr. John Davis:—Would it not be better to refer it to the Drainage Committee and let them prepare a digest of it ?

Moved by Mr. John Davis, seconded by Mr. Evans, that the report of the Drainage Committee be received and printed in the Minutes; and that the Drainage Committee be asked to prepare a digest of the case cited in the Committee's report which should also be printed in the Annual Report. Carried.

DISCUSSIONS.

STANDARD OF MEASURE.

Mr. Sankey:—I see that Mr. M. J. Butler is in the room. I had hoped that he would have been here this morning to hear what was said with regard to the standard of measure. We have a few minutes yet before the time for hearing Captain Bernier's lecture, and I would suggest that the time be filled in by a few remarks from Mr. Butler.

Before I take my seat I would like to say in reference to the proposed Standard which was presented, and which is in feet and 10ths, and links and 10ths, that a member of the Association suggested that before this Standard would be worn out, or before the value of it would have been earned by the surveyor who had it, the metric system would probably be adopted, and that we must not be too quick in adopting the old-fashioned Standard. I make these remarks because I know that Mr. Butler has a good many ideas on matters of this kind.

Mr. Butler:—I had intended on the discussion to touch upon the origin of the British Standard, and to show the manner in which it was fixed. But Mr. Sankey suggests that I just deal for a moment with the metric system, as distinguished from ours. Some years ago—in 1885—there was a paper laid before the Institute of Civil Engineers in England, by which it was sought to show the advantages of the metric system, and the disadvantages in the way of loss and trade those using the British and English measures throughout the world were suffering from because of their failure to adopt the metric system. At that time I had no personal experience in the matter, except in a little way, from an academical standpoint; and it did seem to me the criticisms of those who were in favor of retaining the English system were simply evidences of the conservatism of Englishmen and that hundreds were more in favor of the metric; but since that time I have had some work to do under the metric system, and I found it involved a good deal of calculation; and as a result

of that experience I am not in favor of the general application of the metric system to engineering contracts. The changes that would be involved are so great as to practically render the whole of our accumulated engineering literature valueless. That in itself is a very serious matter. I do not think there is a lathe, or a screw or a bolt or a single one of the essential elements that go to make up a machine, or a bridge, that could be converted from the one measure into the other. We would simply have to abandon our present standard of measure, and by using perhaps data that is accumulated for a convertible unit, start all over afresh and not attempt to make use of conversion tables. It is a delusion and a snare to think you can take a conversion table and fit the English system into the metric or vice versa. The difficulties are such as would overwhelm a man even to attempt.

Besides this, I think in the training of the mind one of the most valuable things a man can learn is to use mental arithmetic well, but most men who attempt to multiply two or three decimals together mentally will find out they cannot do it. If you attempt to multiply ⅛ by ⅛ in the decimal system you have .15625 and so on, and who can multiply these mentally?

I think the remarks I have to make are better stated by Sir Frederick Bramwell who discussed the question before the Society; and as the discussion only occupied a few pages I will just read to you what he says: "Sir Frederick Bramwell, President, said he wished, before the close of the meeting, to ask the indulgence of the members for 0.0833, or it might be 0.1666 of an hour. What was the object of a system of arithmetic? He supposed that it was to be able to make calculations in the easiest manner, and to arrive at sufficiently accurate results.

That is just the point here. I think that one of the most sensible things an engineer can learn is to learn within what limits a measure is reliable. One of the first things he wants to do is to drop three or four places of decimals. The metric system has a tendency to make him go to, not three or four but ten or twelve. I think any finely subdivided recurring decimal of this kind is something we should try to get away from.

"The question, therefore, was whether the system in use in England, or that in use on the Continent, was the more likely to satisfy these conditions. He felt inclined to say, from many years' consideration and experience, that the English system was the more likely to give this satisfaction. Of course a mere

statement of opinion, if unsupported by facts, was of no value, and he therefore desired to give one or two reasons for the faith that was in him. He wished to be allowed to use the decimal system with English weights and measures when he liked, and to use vulgar fractions when he liked. At the present time the metric system was permissive in England, so that any one could use it when he pleased; but he presumed that the object of the author was to have an Act—a compulsory Act—which should forbid the use of the present English weights and measures. What would be thought by the advocates of the metric system, if those who preferred English weights and measures were to introduce a Bill for the purpose of prohibiting the metric and the decimal method. They would, no doubt, look upon such a measure as being very wrong and improper, and he must be permitted, on the other hand, to regard the introduction of the Bill to compel the use of the metric system as being equally wrong and improper. His hearers must not suppose that the advocates of the metric system were not amenable to the charge of seeking to make the continual use of the existing system a crime. The Bill brought in by Messrs. Ewart, Bazley, Baines, Smith and Graves, on the 24th of February, 1868, contained the following penal clauses:"

Then it went on to recite that the metric system must be used, under a penalty and forfeiture of the price if the English system was used.

"There must indeed be an extreme superiority of one system over the other, to justify an enactment that would cause a man to be considered a breaker of the law and liable to penalty simply because he chose to make his calculations by the old method instead of the new one. All that he asked was, that liberty should be left to people to make their own selection, and he thought if that liberty were continued it would be easy to foretell the result. The permission to use the metric system as a legal measure had existed in England for some years, and in the United States for a still greater number of years, but it had not been adopted; whereupon the advocates of the metric system, not content with leaving it to the selection of the people to use that which was most convenient, wanted to force their particular mode upon them by means of penalties. To come now to a consideration of the relative advantages of the two systems.

What were the facts? The Author had spoken of "stones," "drams," "scruples," and so on; but such measures were not used by engineers. He had ridiculed the scale of three-sixteenths of an inch, but, as had already been pointed out, that was one sixty-fourth of a foot, and he believed that his mind was as capable of grasping the idea of one thing being sixty-four times the size of another as it was of being impressed by the motion that the relative dimensions of two objects were 1 and 100. The Author had brought forward a pair of calculations to illustrate the general superiority of the decimal-metric system above the existing English system; but in one sense, and in one sense only, was this calculation that had been placed before them typical of the metrical and decimal system—in the enlarged copy on the wall the decimal point appeared in the wrong place, as it always did."

The comparison that was put on the wall simply showed the different calculations necessary to find the weight of water in a tank measuring 10 ft. 6 ins. by 6 ft. 2 ins. by 1 ft. 1 in., by the English system as compared with the metric system. The calculation shown on page 44 of the report I have referred to, and is as follows:—

"To find the weight of water in a tank measuring:—

Table A

Ft. Ins.	Ft. Ins.	Ft. Ins.		M.	M	M.
10 6	x 6 2	x 1 1	(or)	3.20	x 1 88	x 0.33
10.5						3.2
6.17						1 88
735						256
105						256
630						32
4 785						6 016
61 083						0 33
194355						18048
518280						18048
647850						
4)70162.155						1 98528 tons
4)17540.538						

4)4385.134

7)1096.283

4)156.611

20)39.152

1.957 ton.

That example on Page 44 shows a little more in favor of the metric system in the calculation as the author reduced it to decimals and that makes the English calculation look a very large one and the metric one a very small one; but it will illustrate the point which Sir Frederick Bramwell makes. He says, "Some years ago he went into the workshops of the Paris and Lyons Railway, where he was shown a drawing of a locomotive, with a variable blast-pipe, and he asked what was the maximum and what the minimum area. One of the engineers took a sheet of foolscap, covered it with figures from top to bottom, and then gave him a dimension rather bigger than that of the cylinder. Sir Frederick Bramwell had a two-foot rule in his pocket, and, finding that the drawing was made on the scale of one-tenth, he applied the English inch tenth, and so got out the area and translated it into French measures, which he did in one-fifth part of the time occupied by the man figuring on the paper. He did not displace the decimal point, because he had not got one. Reverting to the calculations on the wall, he wished to show how utterly misleading they were. The Author had placed before the members two comparative calculations, employed to ascertain the weight in tons and decimals of tons of the water contained in a given sized vessel. In consequence of the bulk of water representing the weight in French measures he was enabled to stop in his calculation on arriving at the cubic contents, and to say, "The whole thing is done; there is the weight of the water; but if you do it in English measurements you will have all these additional figures to use before you can get the weight of the water." Assume for the moment the difference in the length of the two calculations existed, what did it prove as regard the general question? Nothing whatever. To what did it apply? To fresh water at a particular temperature, and to nothing else. There was no other liquid on the face of the earth, from ether to mercury, for which it would be true. It was not true for salt water, nor would it even do for fresh water at a different temperature. In any other case a multiplier must

be used to get the weight, which would make the metric calculation as complex as the Author's English example. But who but one whose mind was warped by the metric system would have thought of turning inches into decimals of feet prior to calculation. Would not any one else have worked the sum thus— ?"

And then he works it out by the duodecimal system as follows:—

10.6
6.2

63.0
1.9

64.9
1.1

64.9

5.4.9

70.1.9

"Let any one go to a French railway station, and ask for three tickets from A to B, and it would generally be found that the man (or, as was commonly the case, a woman with a man to look after her) could not tell the amount without taking a piece of chalk or a pencil and making a calculation. The clerk would have no more idea of what three times the single fare was than a child would have. Compare such a person's power of calculation with that of an English butcher's wife or daughter who was in the habit of dealing with pounds and ounces and pence. Let him test the question nearer home. Could many of those present mentally square 3.25 ? He believed very few. But there was no difficulty in squaring $3\frac{1}{4} = 10\ 9\text{-}16$. 10 9-16 was a sum easily appreciated and easily expressed, while 10.5625, the decimal equivalent of the vulgar fraction was much more cumbrous, and he ventured to think did not form any impression on the mind, except that it was a little more than one half. Again, which of them could square 4.125 ? That to the majority would be almost impossible, but with $4\frac{1}{8}$ there was no difficulty. 17 1-64 compared with 17.015625. It appeared to him that a system like the present one, which enabled mental calcu-

lations to be made rapidly and accurately, was enough for all practical purposes. . . . . Water had been referred to as an instance of the wonderful use of the metric system. He would take a water illustration of a simple calculation by the English system. If engineers wanted to know how much a pump would lift, what did they do? They squared the diameter and multiplied by the stroke of the piston in yards, and at once obtained the amount in pounds, as every yard upon the circular inch was a pound. Taking an 8-inch pump, the square was 64; it was making 10 yards a minute—64 gallons a minute—there they had it in a moment. Another instance, 1 inch of rain to the acre was 100 tons, or, to be more accurate, 101 tons. In the United States, where, as here, they had the option to use legally the metric system, they had not used it. Mr. Sellers, one of the best authorities, had said that the thing was not fit to be used. He would refer the members to one who was not a bad engineering authority, Rankin. He would read to them the last verse of Rankin's song in praise of the three-foot rule:—

"Here's a health to every learned man that goes by common sense;
And would not plague the workman on any vain pretence:
But as for those philanthropists who'd send us back to school,
Oh, bless their eyes, if ever they tries to put down the three-foot rule."

That seems to me to sufficiently illustrate the standpoint of perhaps one of the best authorities in England, and a very able engineer who knew something of what he was talking about.

Another gentleman, Mr. H. Bauerman expresses the opinion, "As the result of long experience in the use of various metrological systems in different countries, he was unable to agree with the Author's conclusions as to the desirability of internationalizing the metrical system to the exclusion of all others. He thought that the weights and measures used at any particular time by any people fairly correspond to their local and temporary necessities and as new necessities arose, they would be met by the adoption of new, or by the modification of old, units."

I will wind up by a remark from Mr. Ferdinand Hurter, who says, "That the only important reason for a change from the English to the metric system was that many nations had adopted the latter;" and he compares the yard in this way: "It was in the workshop that the English system was superior to the

French; and the English inch was the standard for screw-cutting, not only in England, but throughout the world. It must not be forgotten that the British public was not prepared, nor preparing for such a change. Decimal calculation was unknown to the mass of the people. Boys were allowed to leave school, having passed the fifth standard, void of all knowledge of decimal arithmetic. Surely it would be unfair to take the masses by surprise. But if the metric system must be, let it be the metric system pure, the metric system compulsory; not a metric system at the option of any engineer. Let there be no mixture, particularly in plans to be submitted to, and discussed by, parliamentary committees." (Applause).

SURVEYORS AS REFEREES.

Mr. McDowall:—Mr. President and Gentlemen, I was made referee, by appointment from Judge Masson, in a dispute over a line in the Township of Howick, in the County of Huron. When the appointment reached me I looked up the Act regarding the matter. The first thing in the Act I noticed is that arbitrators are supposed to take an oath before starting, but there is nothing mentioned in the Act about referees taking an oath. I made enquiries of a solicitor, and he thought I had better take the oath. I took it, and sent it on to the Judge, and I sent certified Field Notes of the line in dispute. I came to Toronto and looked over the rest of the Township in close proximity, for fear the notice I received would not cover the country when I arrived on the spot. When I arrived there I found it was a very easy survey indeed; the original stakes were found and proven without much difficulty. The line had been run by two Provincial Land Surveyors, Mr. Bolton, of Listowel, and Mr. J. McNab. There was a difference of some sixteen feet between us at the back. The depth of the lots in question was fifty chains. The bearing line was the County line between Bruce and Huron; and it was between lots one and two, just eighty rods in width. On the front of the lots we almost all agreed within a few inches. At the back I was further south than either Surveyor; I was eight feet from Mr. Bolton and twenty-four feet from Mr. McNab.

The defendant in the case lost. I sent in my bill, estimating my time at $20 a day. They brought my bill before Mr. Thom, the Taxing Officer at Osgoode Hall, to have it taxed; and I attended on the taxation. Mr. Thom cut my bill down some; he gave as his reason for that that I was there as a Surveyor merely, unless I heard evidence on the ground; that I was only the arbitrator in the case of hearing the evidence; and he would only allow me $20 or at the rate of $3 an hour for the time I spent in taking the evidence on the ground. $3 an hour is what the Act calls for. For the balance of the time he gave me $6 a day and my expenses.

Mr. Kirkpatrick:—I did a little better than that. I was appointed Referee by the High Court of Justice in a case of a disputed survey in the Township of Saltfleet, in 1899, under the

same Act. I went on the ground and I took evidence as an Ontario Land Surveyor in the case. I traced up all I could. I took a good deal of the time in doing it because it was very difficult to find anybody who knew anything at all about the original survey, it having been made in 1797. I then examined into the special section of the Act which related to it, and I searched back to find the preamble of the original Bill. I found there the explanation which of course has not been reproduced in the Act giving the reasons why the Act was changed in that particular case, and fully explaining the whole system of survey and how it should be run. I have since found that there is in Mr. Esten's "Disputed Cases," published by this Association, a decision which was made by the Court prior to the date of the introduction of the alteration of the Act; that bore out my survey in accordance with the Act; and if I had only known of it before, it would have saved me much time and trouble. That case had evidently escaped the notice of the Judge, and of the solicitors on both sides and of the Surveyors on both sides as well, because had they had it they could have at once seen the proper mode of procedure in running that line; because the Court had decided prior to the amendment of the Act that such was the proper way to run it. I fancy after that that it was thought better to introduce an amendment which would set out in definite words what the Surveyor should do. That is, in those townships in which the side lines have been run and the concession lines have not been run, that a side line should be traced out on the ground in the same way in which it was originally run in the first survey. In the Township of Saltfleet, I found, by looking over the notes of Augustus Jones, that he ran one side line from the south to the north, and then crossed over and ran the next side line from the north to the south, and so on through the Township. When a Surveyor is called on to run a side line in any Township he has to use the side line in exactly the same way as if it were a concession line, that is, he must find a point, or two points, on the side line through the township and join those to his original work on the ground. That I did, and sent my report to Chief Justice Armour. I sent my bill in charging $20 a day and travelling expenses; and it was paid without a murmur.

President Ross:—The difference between you and Mr. McDowall apparently is your account was not appealed against.

We are very glad to hear the experience of these two members

of our Association, and it will probably prove valuable to other members.

Mr. McDowall:—Where should these reports be filed ?

The Act calls for plans to be filed in the Registry Office. I sent my whole report to the Judge.

Mr. Van Nostrand:—I think, as far as I can learn, the proper place for filing those papers is with the Registrar of the Court in the County in which the action is begun. I had a case last spring—it was not the same kind of case as we have just heard of—under Section 2 of the Act which provides that the parties before the action comes to trial may agree to refer it to a Surveyor, and in that case the Surveyor is practically the Judge; and the plaintiff and defendant, each by his solicitor, have to be heard by the Surveyor as Referee, just in the same way that an ordinary reference is made at Osgoode Hall. In this case there were three parties to the suit, and necessarily three lawyers and they all insisted on all the legal machinery being proceeded with. The witnesses were called and examined by the solicitor calling them, and cross-examined by the other solicitors; and all the evidence was taken in writing and signed by the witnesses after it had been read over to them. Affidavits, such as are usually taken under Chapter 181, would not do there; it had to be oral evidence. The report of the Referee was to be filed with the Registrar of the Court, and it was so filed, and the Registrar forwarded it to the Judge, and the Judge made his finding on that report. I was so fortunate in this case as to have the Judge agree with me; and if our stenographer will only close his ears for a moment I will confess I charged only $15 a day. My bill went through all right and I did not have to attend any taxation. I think in the end that I came out just as well at $15 a day as if I had made it $20 a day and charged for fewer days. I do not, however, desire this to be considered as a precedent for other references.

President Ross:—Did they allow you a stenographer to take the evidence ?

Mr. Van Nostrand:—The solicitors agreed amongst themselves that one of them who was not, as it happened, actively interested in the case should take down the evidence in longhand. He was familiar with that class of work, and he took the evidence down in extenso while it was being given; and it was all signed while the witnesses were yet there. In other

cases it might be that a stenographer would be necessary, and in that case, of course, he would have to be a Court Stenographer or other properly qualified stenographer. The fact that an unofficial stenographer might be able to do the work would perhaps not be sufficient.

I think it a good thing that this matter has been brought before the Association, because it is an Act that has not been made very much use of as yet; it is comparatively new; and cases may crop up at any time. It seems to me that the Act provides the common-sense way of settling these disputes, because they come before the men who are best qualified to decide on the points; and as a rule the courts will hold with what the Referees decide. The expense is considerably lessened in these cases, because the evidence is taken right on the ground instead of going to the expense of bringing all the witnesses to the legal centre. In the case I had, I know a great deal of expense and a great deal of time were saved and I think the results were probably better than they would have been if taken up before the Judge, and Surveyors only called in as witnesses. The fact that the Act provides that the Referee's charge shall not be less than $10 or more than $20 a day is also rather in favor of the ordinary practitioner.

On the question of the per diem charge, I have made some enquiries and I find that in cases of arbitrations and references to judges and legal practitioners, it is customary to have a consent given, signed by the solicitors for both parties, something to this effect, "It is consented by counsel for both parties that the total number of hours occupied by the Referee in hearing evidence or argument and in considering his award or otherwise in connection with this reference shall be added together and such total number shall be divided by six, and that each six hours of the said total number shall be taxable as a statutory day. Fractional parts of days shall be taxable at the same rate. Adjournments are to be taxable as provided by the Statute.

This prevents any possible chance of an appeal to taxation on the question of the Referee's right to make the per diem charge of $20 per day as provided by the Act.

President Ross:—In what year was the Act passed ?

Mr. Van Nostrand:—It is in the Revised Statutes of Ontario, 1897; and it is published in our Manual at page 37. It is very interesting reading.

Mr. Walker:—Did I understand Mr. Van Nostrand to say that he did not take any measurement on the ground; that he was the Judge altogether.

Mr. Van Nostrand:—I took the evidence on the ground. And I had learned that the former survey had been made many years ago by Mr. Passmore; and knowing that his Field Notes had not been filed, that it was simply a survey ratified by Act of Parliament whereby only the work on the ground and the plan as recorded in the Crown Land's Department were official, it was necessary to have the consent of the parties to consult his Field Notes. These Field Notes I found, after a great deal of trouble, and they practically settled the point. They were very definite as to what was done in that particular case, and they showed clearly how their survey should be made. Without those Field Notes the results might have been very different; but the Field Notes were very satisfactory. Knowing that Field Notes are not considered official, nor considered evidence unless the Surveyor is there to swear to them, I overcame the difficulty by getting the written consent of each of the solicitors acting for the three parties and that estopped them when they came to the Judge. Copies of the Field Notes relating to the question were filed, that was included in their "Consent." Exhibits were put in, I think about a dozen or more; they all had to be put in; and everything was done in the usual court form. This, however, was quite a different style of reference from those referred to by Mr. Kirkpatrick and Mr. McDowall who were called in really to assist the Judge after he had the witnesses before him. In the case I had, the parties agree on a joint Surveyor or Referee and the Judge simply found on the Referee's finding.

Mr. Walker:—The point I wanted to get at was, did you make any surveys at all?

Mr. Van Nostrand:—The surveys were made after the Notes had been consulted, but that was a comparatively unimportant matter; it was simply ranging a line between two points on either side of the concession.

Mr. Walker:—The evidence you took was more to decide on the governing points.

Mr. Van Nostrand:—The evidence was to fix the governing points, and to decide as to whether there was originally a jog at the blind line. The survey was a small matter and (including the planting of six monuments) was done in one $15 day.

President Ross:—You get the Referee's fee for your survey as well as for acting as Judge.

Mr. Van Nostrand:—Yes, throughout.

Mr. McDowall:—I might say that, in my case, I was advised by Mr. Thom to always make my bargain before I started on my reference.

TRACK SURVEYING.

Mr. Stewart:—I can give an account of a little track surveying, (if by that term is understood an approximate survey of a route), that I undertook a few years ago. I was going to spend my vacation in the Rocky Mountains; and we intended to start from a point of the C.P.R. just in the eastern outskirts of the Rockies, and, following the trend of the mountains, keep among them or in their outskirts, nearly up to the source of the Athabasca River. It struck me, before leaving, that it would be rather interesting, as most of the country was almost unknown, if I could bring home some results that would enable me to make a map of our route. I looked through all the different works on surveying that came within my reach but I could find no information as to how such surveys were generally carried out; so I decided to make a traverse of the route, using a prismatic compass to give the direction and a pedometer to give the distance. I knew of course that the pedometer worn in the pocket and carried as one walked along, going up and down the hills and over swamps and wading streams and so on, would give an indication of distance that would very far exceed the straight line distance between any two points; so I assumed that the distance given by the pedometer between two points bore a constant ratio to the straight line distance; and on that assumption I made my survey. Then, wherever possible, once or twice a week, I observed for latitude; I had with me a good marine sextant, reading to ten seconds, and an artificial horizon. I observed also for time, although the watch I had with me was not a very reliable one, but I wanted to compare the determination of longitude given by the watch with the determination by dead reckoning afterwards. On my return I set to work to make a map from my notes and observations. I fixed the geographical position of the starting point from one of the Geological Survey maps—it was a point near the C.P.R., which was pretty well determined, so I had no difficulty in fixing its position geographically, fairly closely. I then drew on a scale of five miles to the inch, the meridians and parallels of latitude within the region which we had explored. Then, with reference to these meridians and parallels I located the position of the starting point. From thence I plotted my traverse, correcting my compass readings for variation; and reducing my pedometer distance from point to

point by about a third, so as to approximate to the straight line distance between points at which bearings were taken. I plotted the traverse then from the starting point to where my first latitude observation was taken. I found the position of this point with reference to the nearest parallel to be a little too far north, on comparing it with the observation for latitude. Then assuming that the pedometer distance between two points bore a constant ratio to the straight line distance, the direction of a line joining the terminal points of an extended traverse would be correct; so I joined the point determined by dead reckoning at where the first latitude observation was taken with the starting point, and then at the point in which that line intersected the parallel drawn through the latitude observed. I located the point; and then I squeezed the whole traverse in and made it fit between those two points. The plotting of the traverse line on the map was carried on in the same way to where the next latitude observation was taken, and that point was located, in the same way, as just described. In this way I plotted the whole route.

I afterwards plotted the topography, sketched in the mountain ranges and streams, and so on, with reference to the traverse line. I have reason to believe the work was fairly correct. Our route lay in a north-westerly direction, so that it was the best direction for surveying in that way. I was able to compare the position of a certain sketch of the Athabaska River; determined from my survey, with its position as determined by Captain Pulliser about thirty years previously. He explored from another direction; he went from Edmonton, and crossed the Athabaska, working up to the Jasper House, and carrying on his explorations from there to near where we left off. He spent several months, I believe, at the Jasper House, and made a number of determinations by lunar distances of the longitude of that place. From the Jasper House, in going up-stream along the Athabaska, you are going nearly south, so that the longitude of the point where we ended our explorations is about the same as that of the Jasper House; and comparing the position of this stretch of the Athabaska River with its position as given by Pulliser, they agree within a fraction of a mile; and as my determination was made altogether by dead reckoning, merely correcting a traverse line by latitude observations, it is a very good check on the accuracy of the whole survey. I think this is the best method to follow in making a track survey. The great difficulty of course in mak-

ing such a survey is to get a reliable determination of distance; but if some method is used that will give a determination of distance that will bear something like a constant ratio to the true distance I think you can, by correcting your work by frequent latitude observations, make a survey of a considerable portion of country from which a good map can be constructed. The map that I made from about two months' work covered a piece of country about 300 miles long by 50 or 75 wide; the survey was made single-handed and I think was fairly accurate.

Mr. Tyrrell:—What method did you adopt in determining the variation ?

Mr. Stewart:—The method I frequently adopted was, after observing for time, to take a number of compass bearings of the limb of the sun, noting the time, and then afterwards comparing the true bearing of the sun's limb from its declination at the time, its hour angle, and the known latitude. Having found the true bearing in that way, a comparison of the compass-bearing gave the variation.

Mr. McDowall:—Suppose the country in one place was very level would it bear the same reduction of distance ?

Mr. Stewart:—It would not, strictly speaking; but in the long run errors would tend to compensate one another.

Mr. H. H. Gibson:—How closely can you determine latitude with a sextant ?

Mr. Stewart:—Comparing my different latitude determinations, I think with a marine sextant like mine, with an artificial horizon, you can get latitude within ten seconds, by making a number of determinations by circum-meridian altitudes, and taking the mean, assuming there is no eccentric error in your sextant. There might be a large eccentric error which should be determined.

President Ross:—You said you did the work single-handed. I suppose you had assistance to carry your outfit. I presume you speak of the instrumental work when you say that.

Mr. Stewart:—Yes. Our party consisted of three besides myself, and then we had a couple of Indian guides and packers. I meant as far as the instrumental part of the work was concerned.

PAPERS.

[This Association is not responsible as a body for the opinions expressed in its Papers by Authors.]

LOCAL DEFLECTION OF THE PLUMB LINE.

BY OTTO J. KLOTZ.

In the present short paper it is only intended to lay before the Society certain data of the deflection of the plumb line as found by latitude observations and azimuth surveys along the International Boundary, 49th parallel, from the Lake of the Woods to the Pacific Ocean. Those westward, as far as the Rocky Mountains, were published years ago in the United States Report of the Northern Boundary Survey, but those of British Columbia have, to my knowledge, never been published. The effect of deflection of the plumb line on longitude and azimuth observations is not considered in the present paper.

Deflection of the plumb line may be defined as the deviation of the vertical at any point from the normal at that point to the surface of an assumed figure of the earth. In dealing with the earth, we must assume its shape to be of some definite geometrical form and of certain dimensions, for only then can observations, at different points thereon, be correlated and adjusted. The best assumed form (Clarke's 1880 spheroid at present), however, differs at places widely from the actual form or geoid. To illustrate, if the continents were traversed by narrow canals, communicating with the ocean, their surface, although level, would be wavy or undulating, and would be in some places above, in other places below the surface of the spheroid or ellipsoid of revolution, the divergence of the two surfaces being probably confined to a few hundred feet.

The position assumed by the plumb line, is due to the law of gravitation, that is, it is the integrated result of the attraction of the individual particles, composing the mass of the earth, and hence the position is affected by the relative distribution of them. We may, therefore, say that the unsymmetrical distribution of the particles, whether on the surface, as mountains, etc., or in

the thin crust, is the cause of the deflection of the plumb line from its theoretical position. The ablest mathematicians have been engaged, ever since the era of precise measurement, upon this difficult question of the form and dimensions of the sea level surface.

In some instances we are quite prepared to find local deflections of the plumb line, for example, when observations are taken on the plains at a point near a more or less isolated upheaval, as the Three Buttes or Sweet Grass Hills in Montana, just south of the International Boundary. These hills, as we shall see later, pulled the 49th parallel out of its theoretical position about 800 feet. On the other hand, large deflections show themselves without any visible reason or cause as evolves from numerous observations and their geodetic connection. A remarkable instance is that of the comparatively plain area surrounding Moscow, which I visited recently, where, on the margins of an eighteen mile east and west zone, large deflections of opposite signs were found. From this it must be concluded that there exists beneath the surface a cavity or at least matter of small density.

It is evident, therefore, that the observations alone, at any particular point, are not conclusive for fixing its geographical position upon the surface of the earth, but that numerous astronomically determined points must be connected linearly by triangulation, and from their inter-accordance, or discordance, the most probable values determined, based upon an assumed figure of the earth.

In our own city here (Ottawa), there appears, due to the topographical configuration, to be a deflection of the plumb line; for, the latitude determinations made by me at the observatory on the summit of the escarpment, compared with those made some years ago by Mr. Lindsay Russell on the opposite side of the river, show a discrepancy of about a second of arc, equal to about a hundred feet, a quantity greater than the error of observation. However, a more or less extended hypsometric survey would be necessary for a plausible *a priori* conclusion with reference to the probable discordance in latitude to be expected between two stations.

All observations for the determinations of positions upon the earth depend upon the direction of the vertical. Latitude and longitude observations, the surveyors' and engineers' operations, all have their zero of reckoning in the centre of the level bubble,

and any displacement of the latter, which is equivalent to the displacement of the plumb line, affects the results, and will show discordances when widely separated observations are geodetically connected.

It may be stated that a delicate level used for latitude work, reading to a second of arc, has usually a radius of about 1,700 feet, or nearly a third of a mile, for the curve ground on its inner upper surface.

To digress for a moment.

Boundary lines may be divided into three classes: those representing a social unity, those representing a physical unity, and those representing a political unity. Those of the first find the largest number of representatives in the older settled countries, for the primal concept of boundary was to conserve the social unity. It was not to define territorial extent as much as to define or assert the domain of a like people; like by language, race, or religion or other affiliation. Such boundaries are, as a rule, very irregular and difficult to describe. When the social organism reached that development that written treaties became necessary between adjoining peoples, the description of the separating boundary was made from the boundary *de facto*, and the boundary not laid down from the description.

The second class we may consider an expansion of the first, resulting from conquest, whereby a physical as well as a social unity was to be preserved. Of the physical boundaries—mountains, rivers and lakes—to serve the purpose of barriers, by mountains, that end is undoubtedly best attained. Europe furnishes a number of examples of this.

The third class, which we may call the astronomic boundary, is a development of recent times, and applies invariably to areas practically unsettled, unsurveyed and little known. Such can be laid down on paper, or described in treaties without scarcely any knowledge of the country whatsoever.

While Europe furnishes the most examples of the first, America does so of the last. Many of the State boundaries of the United States are astronomic lines, either meridians, parallels, or lines of definite azimuth. Similarly with the subdivision of Australia and recent boundaries in Africa. Astronomic boundaries may generally be taken as an index of the ignorance existing of the country or area involved and its resources.

Boundaries under the first division are difficult for definition or restoration when such is necessary. Those of the second,

always dependent upon water, are generally self-evident, while those of the third are comparatively easy of determination.

There are instances of a fourth class of boundaries—where the position of it is dependent upon the position of a physical feature—e.g., that it be at or within a given distance from a river or the sea.

A notable case of the last is that of south-eastern Alaska, as described in Article 4 of the Convention of February 28, 1825. Such boundaries are exceedingly difficult to lay down on the ground, requiring, too beforehand laborious mathematical calculations. The Railway Belt of British Columbia, extending twenty miles on each side of the Canadian Pacific Railway, gave the writer an example of such computation.

A river, and least of all a large river, a commercial artery, forms an undesirable international boundary. The very nature thereof makes it a route of travel, and hence of settlement on its banks, which, if in possession of two countries, is almost sure to lead to trouble. Hence we find few or no large rivers forming such boundaries, although our own St. Lawrence does for a short distance separate us from our southern neighbor. A summit or watershed boundary is pretty satisfactory, if restricted to mountains, but when applied to plains or undulating country, is fraught with difficulties. The difficulty consists in establishing the line of watershed, as was presented in the Maine-New Brunswick controversy early in the century.

Of the several classes of boundaries spoken of, none is as immutable as the astronomic one. Of the first, the original monuments and records may disappear, and personal evidence be wanting. Of the second or physical boundary, time may bring about changes quite as marked and cause the line to move therewith. As a well-known instance, the Mississippi may be cited. In a recent report of the "Idaho and Montana Boundary Line" we have another illustration. It is stated that "from a geological standpoint, but hardly from a practical one, however, there is another reason why monuments should not be placed on the summit of the Bitter Root range, as marking the boundary line between Idaho and Montana. There is abundant evidence that the summit is what is known as a retreating or migrating divide; in other words, the waters tributary to the Bitter Root River in Montana are continually capturing by erosion those of the Clearwater River in Idaho, so that the divide is slowly being shifted to the westward, thus adding to the territory of Montana

and diminishing that of Idaho. The existing divide is uniformly from six to eight miles from the irregular line representing the original divide, if the latter may be accepted as having passed through the highest points of the range, which seems probable."

When a boundary is defined by a parallel of latitude, the question invariably arises, in the demarcation of it, whether the astronomic or mean parallel is to be adopted. The astronomic parallel is that line on the surface of the earth on which direct observations for latitude give the same elevation of the pole; geometrically, for the spheroid or ellipsoid of revolution, it is the intersection of the cone, having its apex in the minor axis of the earth and making an angle therewith equal to the complement of the latitude, with the surface of the earth. Principally owing to the local deflection of the plumb line, points astronomically determined in latitude will not "close," that is, the line projected or run from one station as a parallel will not meet the next point or astronomic station.

That line with reference to which the sum of the discrepancies north is equal to the sum of those south is the mean parallel.

However, as the latter can only be determined *after* the location and connection of the astronomic points, entailing revision of the whole work, and besides the difficulty of re-establishing points on the mean parallel in case of loss or disappearance of monuments and marks, it has generally been decided to adhere to the simpler and more readily established astronomic parallel. All such parallels traced upon the earth are irregular curves.

The International Boundary Line, between the Lake of the Woods and the Rocky (Stony) Mountains is defined in the second article of the Convention of 1818 as being the parallel of 49 degrees north latitude. The immediate cause of the delimination of the boundary was the discovery that the fort of the Hudson's Bay Company at Pembina was nearly a mile within United States territory.

The field work was begun in September, 1872, and finished in the same month two years later, while the proceedings of the joint commission were brought to a conclusion May 29, 1876.

On this line of 860 miles, 40 astronomic stations were established, and 388 monuments erected.

After due consideration, the commissioners agreed upon the astronomic parallel. The recommendation for this, by the chief

astronomers of the commission, was based on the following grounds: "1st That the portion of the parallel of 49° included within the operations of the commission, being only about one-twentieth of the entire circle of latitude, was not sufficient to fix, with any mathematical accuracy, the true position of the mean line of 49°, and that, therefore, if such a parallel were described, depending on the mean of the astronomic stations, no known point of the boundary would be in latitude 49°; 2nd That as the amplitude of the arcs, included between the mean and the astronomical parallels, would in many cases be very considerable, grave errors and complications might arise in the subsequent re-survey of any lost portion of the boundary; 3rd That the definition of a mean line would involve a re-adjustment of the whole boundary, after the first careful survey should have been completed, and consequently a very considerable increase of expense without any practical benefit accruing; 4th That for every purpose except that of geodetic computation, a parallel of points determined astronomically (instrumental errors aside), is a true parallel of latitude, and therefore, fulfils the stipulations of the treaty under which the joint commission was organized."

Accordingly, astronomic positions were determined at approximate intervals of twenty miles. These stations were connected by tracing upon the ground tangents to the prime vertical circles at each successive point. From these tangents, checked and corrected for errors of azimuth, the calculated offsets to the small circle of latitude were measured at convenient intervals, varying from one to three miles. From the last mentioned offset the relative station error (deflection of plumb line) was found and distributed between the two stations in the ratio of the distances where offsets were taken. From this method it results that the boundary line, as actually traced, is an irregular curve, affected at each astronomical point by instrumental errors and by the local deflection of the plumb line, making the closest probable approximation, at every point, to a true astronomical parallel.

Of the forty astronomical stations on the 49th parallel, four were observed jointly, seventeen by the United States astronomers and nineteen by the British. The mean of the probable errors of the British stations was ± ".088 and of the United States ± ".059. The average of the probable errors is then a little over seven feet.

The greatest difference of station errors is 13."89 or 1.407 feet, being in a distance of 97 7-10 miles, between the Cypress

Hills to the north of the boundary, and the Three Buttes or Sweet Grass Hills near, and to the south of the 49th parallel. The station error of the former is + 5."94, of the latter — 7."95, that is, the Three Buttes pulled the 49th parallel 805 feet south, and the Cypress Hills 602 feet north of the mean parallel. The greatest discrepancy between adjacent stations, about twenty miles apart, is 7."28 or 738 feet, near the Three Buttes. From Lake of the Woods, westward, into the valley of the Red River, the station errors increase, and for a reason, which from our lack of knowledge of the underlying strata, must be conjectural. The escarpment of the Pembina Mountains (elevation would be a more appropriate term, height 1,695 feet), naturally draws the vertical southward, continuing to do so until the Turtle Mountains (of moderate elevation, 2,550 feet) are reached, which, too, deflect to the south. After entering the Coteau of the Missouri we pass along the southern base of the high ridge separating the waters flowing into the Gulf of Mexico, from those flowing into Hudson's Bay, and find, naturally, a deflection to the north, increasing to a maximum, south of the Cypress Hills (3,800 feet). Here the enormous intrusive masses of the Three Buttes, produce a violent disturbing effect, drawing the astronomical parallel to the south, at an average rate of 14 feet to a mile, for a distance of about one hundred miles. When we actually enter the tumultuous Rocky Mountains, with all their varied conditions of compositions, of faults and dykes, and our lack of hypsometric maps, we are unable to even make a plausible estimate in which direction the local deflection is to be expected. Even the relative deflection between adjacent stations remains unknown in most cases on account of the great difficulty in connecting them geodetically.

As a very remarkable example of the deflection of the plumb line may be mentioned, the one on the arc of the meridian between Andrate and Mondivi, in northern Italy, where in a distance of a little over seventy-seven miles, a difference of nearly forty-one seconds was found, that is to say, the difference in the distance between these two terminal points determined by direct astronomic observation, and also linearly by triangulation was found to be about 4-10 of a mile. How much of this quantity is attributable to each place for local deflection, and again, how much is due to relief or topography, and how much to the unequal distribution of masses beneath the surface of the earth, is not known.

It is evident that observations at two places which are also geodetically connected, can only give the relative deflection of the plumb line.

For the boundary between the Lake of the Woods to the summit of the Rocky Mountains, the Commissioners agreed that the line joining any two adjacent monuments shall be an arc of the parallel. This was to apply, too, in the case of restoring any monument whose position was lost. This agreement differs from that of the boundary commissioners, who had charge, some seventeen years previously, of defining the boundary from the Gulf of Georgia to the summit of the Rocky Mountains. They agreed that the connecting line between monuments shall be a straight or direct line, i.e., an arc of a great circle.

The international boundary commission appointed to define the boundary under the first article of the Treaty of June 15, 1846 (the present southern boundary of British Columbia), was organized in 1858 (first meeting August 13th), and in the summer of the same year began field work at the western terminus of the boundary. The observations and surveys were carried eastward under great difficulties, owing to the heavy forest and mountainous character of much of the country. Early in 1862 the field work was completed and the preparation of the maps begun, which were, however, not completed and jointly signed by the commissioners till 7th May, 1869. A report was never published.

Between the extreme east and west points, upon the watershed of the Rocky Mountains, and the eastern shore of the channel which separates the continent of North America from Vancouver Island in west longitude 114° 03′ 34″ and 123° 3′ 53″ respectively, the exact length of the boundary line upon the 49th parallel of north latitude is 4094-10 miles. The position of the parallel was determined by 28 astronomical stations, 11 of which were established by the British Commission, 14 by the American Commission, and 3 were observed by both. Another station was fixed by the British Commission at Schweltza Lake,but it was at the time rejected on account of the apparently large deflection of the plumb line, though the after experience of the most accurate instrumental observations in that mountainous country, led to the conclusion that the result at Schweltza was quite as trustworthy as any of the others. It is, however, not included in the final determinations.

At the first meeting of the Commissioners at Semiahmoo, August 13, 1858, it was concluded, after discussing plans for determining and marking the line as far as the Cascade Mountains, to be inexpedient at that time, in consequence of the great expense, consumption of time, and the impracticable nature of the country, to mark the whole boundary by cutting a track through the dense forest. It was therefore agreed to ascertain points on the line by the determination of astronomical points at convenient intervals on or near the boundary; and to mark such astronomical stations or points fixed on the parallel forming the boundary, by cutting a track of not less than 20 feet in width on each side for a distance of half a mile or more, according to circumstance. Further, that the boundary be determined and similarly marked where it crosses streams of any size, permanent trails, or any striking natural features of the country. In the vicinity of settlements, the line to be cut a greater distance. Bessel's value of the figure of the earth was adopted.

From the two points on the parallel, dependent respectively, on the Sumass and Schweltza astronomical stations, cuttings were made to connect the points. When the cuttings met, there was found to be a discrepancy of 8″, say about 810 feet; they were, however, connected, though the line thus defined is obviously not strictly *the* boundary of the treaty. The distance is about 9¼ miles. This relative deflection of the plumb line, 8″, in so short a distance, is the largest on the whole 49th parallel, from the Lake of the Woods to the Pacific. When the cuttings on the parallel from Sumass and the British station at Semiahmoo met, there was a discrepancy of 114 feet in the 20 miles, and between the United States astronomical station at the east shore of Semiahmoo Bay, and the British one five miles east thereof, a discrepancy on the parallel of nearly nine feet was found, an error quite within the error of observation.

The only other cutting on the whole boundary line west of the Rocky Mountains, connecting adjacent astronomic stations is between the Similkameen and the Columbia rivers, a distance of 96 miles. The stations there in order eastward are: Similkameen (U.S.); Lake Osoyoos (Br.); 1st Crossing Newhoilapitkw (U.S.); 2nd Crossing Inshwointum (Br.); 3rd Crossing Statapoosten (U.S.); and on the Columbia (Br. and U.S.). From the point on the parallel at Lake Osoyoos, a line was run east and west 30⅕ miles, connecting with similar points at Similkameen and at the 1st Crossing. The line was found to

strike 509 feet north of the former point and north of the latter 364 feet, showing a marked deflection of the plumb line. When, similarly, an east and west line was run from a point on the parallel at Inshwointum, it was found to be south 300 feet of the point on the parallel at the 1st crossing, and 180 feet north of the point at Statapoosten.

This shows, therefore, a discrepancy between the latitude of Lake Osoyoos (Br.) and Statapoosten (U.S.) of 844 feet, due to local attraction or difference of local attraction. After verifying the accuracy of the latitude observations, it was decided to adopt the mean parallel, based on the differences found, between Similkameen and Statapoosten—a distance of 71 miles. This is the only part of the whole boundary line between the Lake of the Woods and the gulf of Georgia, where a mean parallel has been adopted for the boundary, instead of the astronomic parallel. These seventy-one miles were re-cut on the mean parallel. From the extremity of the mean parallel at Statapoosten, an east line was run to the Columbia, where a difference of 212 feet was found between the mean of the British and United States latitude determinations there and the mean parallel. The line (for final boundary) was thereupon deflected from Statapoosten so as to strike the above mean Columbia position of the 49th parallel.

The actual definition of the boundary is as follows: Its western extremity is marked by a substantial granite obelisk in longitude 123° 03′ 53″, west, standing upon a steep cliff on the western face of the promontory of Point Roberts, about 160 feet above the sea. For 44.8 miles eastward there are 42 iron pillars placed at suitable points on the boundary. One pillar stands on the eastern face of Point Roberts, 2 miles 704 yards from the obelisk, and there are two intermediate pillars in the interval at average distances apart of somewhat more than ¾ mile. A pillar on the west shore of Semiahmoo Bay is 12 miles 1,777 yards from that on Point Roberts on the opposite side of the bay; and thence is 29¼ miles to the easternmost pillar, the average distance apart is about 1,380 yards, varying between 1 mile 1,245 yards and 198 yards on the opposite bank of the Sumass River. These pillars all stand in a continuous cutting through the forest or in intervening patches of swamp and prairie. From the easternmost iron pillar, to the right or west bank of the Similkameen river is 107.9 miles, the boundary is defined in the vicinity of 9 astronomical stations by 19 cairns

or pyramids built of dry stones, and one bench mark cut on the face of a rock at Ensakwatch; and at several stations short vistas were also cut in the forest, between the cairns. This wide interval comprises the rugged and inhospitable region of the Cascade Mountains. One of the widest unmarked intervals on the boundary occurs in these mountains, between Pasayten and Naisnulch, the distance between the marked points being 23.7 miles. From a cairn at the foot of the mountains on the west side of the Similkameen river to the east or left bank of the Columbia, the boundary for 95 miles is well and continuously marked by 69 stone cairns and one mound of earth, and by forest cutting in all necessary cases. This was the most favorable portion of the work, part of the line passing over rolling prairie country interspersed with wood; but very considerable portions were also mountainous, rugged and heavily timbered, though more accessible from the valley of the Newhoialpitkw (Kettle) river than were the Cascade Mountains. Two cairns stand within 129 yards of each other on the east bank of the Columbia (one having been placed by each Commission) and the average distance apart of the remainder is 1 mile 679 yards. From the hill tops the line of boundary defined by cairns and cuttings can be traced for many miles. For the remaining 161.8 miles between the eastern cairn on the left bank of the Columbia river and the terminal point on the watershed of the Rocky Mountains in west longitude 114° 03′ 28″, the boundary passes over successive mountain ranges intersected only by the valley of the Kootenay River at two points 75¾ miles apart and by the adjacent valleys of the Flathead river and its tributary Kishenehu creek. This portion of the line is marked in the vicinity of 9 astronomical stations, by 26 cairns and one bench mark cut in the face of the rock at the Kootenay Mountain Station, and by a cairn fixed by survey on the trail between Kootenay west and Mooyie station; and the usual forest vistas cut at the usual defined points, besides longer cuttings of seven and ten miles at the eastern crossing of the Kootenay, and between the Flathead and Kishenehu rivers. On the summit of the Rocky Mountains the monument consists of a pyramid of dry stones, situate on a narrow saddle with precipitous sides connecting two lofty mountains, serving to identify the locality between the Columbia and the Rocky Mountains, exclusive of the Mooyie trail cairn, and the intervals between the Kootenay mountain and Kootenay west stations, and Mooyie and Yahk stations, the distance between the conse-

cutively marked points at the several astronomical stations averages about 13¼ miles; but between the stations named they extend to 25 and 24 miles owing to the inaccessible nature of the intervening country, which is quite as bad as the Cascade Mountains.

As already stated, the Boundary Commissioners had agreed to understand the boundary laid out by them, to consist of a series of straight lines between the successively marked points, without regard to the distances between those points or the curve of the parallel in the longer intervals. That they did upon the consideration that it was of the greatest importance that nothing should be left for future discussion of settlement, and that the operations should be final and conclusive. It may be stated that opposite the centre of a chord of 25 miles in length, the departure from the 49th parallel would be about 40 yards, and of 12 miles, 9 yards. Both these departures are probably far smaller than the deflection of the plumb line, at the governing astronomical stations.

We have, therefore, in the actual boundary line of British Columbia, a deviation from the 49th parallel, as given in the treaty of 15th June, 1846, in so far, that the straight lines replace the curve of the parallel between all the stations, and furthermore, that between Similkameen and Statapoosten, the mean parallel was adopted instead of the astronomically determed points.

We have followed now the 49th parallel for 1,270 miles, about one-thirteenth of its circumference, and it has disclosed to us some of its vagaries as manifested in the latitude component of the deflection of the plumb line. This boundary line is the longest astronomic one on the earth, the nearest approach to it being the meridian separating West Australia from North and South Australia.

The same law or force which causes the deflection of the plumb line, determines the length of the seconds pendulum, preserves the planets in their orbits, and maintains the stability of the universe—is the law of gravitation. Our earth furnishes us with many interesting problems, and the very discordances observed—apparent though they are—tend to lead us on to unravelling the mysteries and intricacies of nature, and to unfolding the unity and harmony of the cosmos.

DISCUSSION.

Mr. Aylesworth:—Not very long ago some newspapers stated that the boundary between Canada and the United States had to be re-run. Is there any question of that ?

Mr. Sankey:—I think if there is anything to be done it will be simply to replace some of the monuments.

Mr. Aylesworth:—Some that have been lost or effaced.

Mr. Whitson:—I think the question arose as to the boundary line between Lake Superior and the West Shore of Lake of the Woods (of which there was not a very accurate survey made), taking in Hunter's Island.

Mr. Sankey:—Doesn't that boundary come under the second clause ? Isn't that a physical boundary ?

Mr. Whitson:—Yes.

Mr. Aylesworth:—I do not see any object in retracing a physical boundary except in order to lay it down accurately on paper.

The President:—I think Mr. Kirkpatrick gave us an explanation with regard to the Hunter's Island dispute a year or two ago, when it was discussed in the papers. But it would be better just now probably to stick to the points brought up in Mr. Klotz's paper and if any one has any remarks to make or any motion to bring forward we will be glad to have it.

POLAR EXPEDITION.

BY CAPTAIN J. E. BERNIER.

As a Canadian I feel greatly honored in having this opportunity of explaining in the Queen City of Canada my plans for exploring the unknown portions of the Arctic Basin, and reaching the highest latitude possible, sailing through the Strait of Behring, and I hope with the help of God to reach the Geographical Pole.

The desire to draw aside the veil of Arctic and Antarctic is certainly upon us.

Of what use will it be ?

To such a question my reply is:

That both Arctic and Antarctic are of great importance for scientific purposes and commercial in general, if it be merely to contend in what has become an international competition; no country is so ready to appreciate, and reward the explorers of other nations or to show so much sincere generosity as our own; and it will be an evil day for Great Britain and Canada when they cease to take part in what has become a competition between all the foremost nations, and are content to yield their portion in the race for Arctic and Antarctic discovery. Our place has been too long in the front rank for us to back out and allow other flags than the Union Jack to wave in the most prominent position.

With the index pointing towards the Poles, our word should be " Forward " and by our action in following that direction we should show the world at large that we are worthy of being called sons of the foremost nation.

The results of scientific importance to be derived from an examination of the immense unknown area round the North and South Poles are as numerous as the region to be explored is extensive. It may be shown that no such extent of unknown area, in any part of the world, ever failed to yield results of practical, as well as purely scientific value; it is impossible that its examination can fail to add largely to the sum of human knowledge; further it is necessary to bear in mind that the Polar Area is, in many most important respects, of an altogether special character, affording exclusive opportunities for observing the condition of the earth's surface, and the physical phenomena there to be seen, under certain singular circumstances, which are

due to the relation of this area to the position of the axis of revolution of the territorial spheroid, and which have to be considered not only with reference to the present time, but to the earth's past history. It may be, therefore, received as certain that discoveries will be made in all branches of science, the exact nature of which cannot be anticipated.

GEOGRAPHY.

A geographical problem of great importance and interest will be solved by completing the circuit from the Straits of Behring via the Pole to Greenland and Spitzbergen towards the Atlantic.

HYDROGRAPHY.

The necessity of investigating the depth of the Polar Basin current and out-put of the surface water, and the amount of ice and sea temperature at various depths.

GEODESY.

A series of pendulum observations at the highest possible latitude as well as the direction of the force of gravity, and such observations would be especially valuable at 90 degrees north.

METEOROLOGY.

Observations of the temperature and pressure of the atmosphere and of the prevailing winds with reference to currents in very high latitude will form valuable contributions to Meteorological Science.

The climates of Europe and Canada, in no small degree depend on the atmospheric conditions of the Polar Area, in which the development of extremely low temperature necessarily leads to corresponding disturbances, the effects of which are felt far into the temperate zone.

MAGNETISM AND PHYSICS.

The extension of research into the Phenomena of Magnetism and atmospheric electricity in the vicinity of the Pole, where so many of the forces of Nature operate in an extreme degree, either of excess or defect.

THE STUDY OF AURORA BOREALIS.

The Study of Aurora Borealis which is amongst the most striking phenomena visible on our planet, and is almost impossible in low latitudes.

GEOLOGY.

A more complete investigation of the Geology of the Arctic regions is extremely desirable, both for its scientific importance and the value of its practical results. The geographical position of Island seen by Dr. Nansen and the crews of the "Jeannette" should be ascertained and some unknown islands may be found in shallow water near the new Siberian Islands. The distribution of small buoys along the course of the voyage from the Straits of Behring to where we will stop in the ice will record the time it takes to traverse the Polar Basin.

BOTANY.

The vegetations, wood and diatoms found in the Polar Basin will require to be studied.

ZOOLOGY.

The life of animals and different species of fish in the Polar Basin will also be observed.

ETHNOLOGY.

Ethnological observations with regard to unknown lands that may be discovered, the distribution of land and water in the Polar basins and many other scientific researches.

Let me explain my views of the Polar Basin.

First, we must divide the nearly stationary ice from the moving ice. We have to draw a line from Greenland to Point Barrow and as we know that Nature does not run any straight line, we have to put a curve to it, as we know that there is accumulation of ice, that has been seen so often by celebrated mariners.

In 1850-51 Captain Collinson's Ship "Enterprise" passed through the Strait of Behring in search of Sir John Franklin, the ship got into the heavy pack-ice, and the ice was extraordinarily thick and impassible, resembling rolling hills. This, with the experience of other explorers, seals the route towards the Pole passing near the Parry Islands. Another argument that I can bring forward is this:

What has become of the relics of all whalers that have been lost in the neighborhood of Point Barrow? They are in this heavy pack-ice, and are pressed upon the shores of the Parry

Islands, and probably never come out of the Polar Basin, being kept back by Grantland and Greenland.

The reports of Sir George Nares and Commander (now Admiral Markham), have proved the age of the ice and its thickness and motion.

SECONDLY, THE MOVABLE ICE.

This portion was well defined by the drift of the "Jeannette" and the "Fram," during the two years' voyage of the former vessel, and three years of the latter, but what we want now is to connect the two drifts into one. The drift ice to the east of the "Jeannette" track will naturally drift more slowly, and in my opinion would take longer time to get to the Atlantic Ocean.

THIRDLY:

The drift in the Polar Basin by the "Fram" and the "Jeannette" is now better defined, and it indicates that the "Jeannette" drifted on the western edge of the deep Ocean; we must conclude by the height and length of Greenland that the deep tongue of the Ocean in the Polar Basin is as long as the land of Greenland, for the depth of this Ocean corresponds with the height of Greenland, and the sooner a ship can get into deep water, the sooner she will get across the Polar Basin, towards the Atlantic.

FOURTHLY:

THE UNKNOWN ISLANDS.

We may expect to see new islands in the neighborhood of the new Siberian Islands, but no land where the water is deep. Wrangell Island and the new Siberian Islands are parallel with the range of mountains that runs in North America from Alaska towards the westward. Another point which indicates the movement of ice to the westward is open water in summer, west of the land, while to the eastward of land there is ice accumulation which obstructs navigation. To the west of the Alaska Coast, New Siberian Islands, Frank Joseph Land, Spitzbergen, Greenland, Ellemereland and Banksland, there is open water. The Polar Basin to-day is more navigable than it was 200 years ago. There is quite a change for the better in the temperature; open water has been more and more apparent.

FIFTHLY:

The wind problem will also favor a ship by the Behring

route. We must divide the Polar Basin into two parts. In the eastern part the prevailing winds blow towards the Behring Sea and Strait, while on the western part the wind blows towards the Atlantic. Thus an expedition starting from that route would be favored by the wind and the overflow of the Polar Basin, which is caused by the rivers of Siberia, and the thaws of ice and snow during some months in summer, and the rotation of the earth.

Regarding Diatoms found in Greenland and at the Strait of Behring, Dr. Nansen says:

"It is indeed quite remarkable that the Diatoms found off Behring Strait and on East Greenland should so completely resemble each other; it points to an open connection between the Sea east of Greenland and North of Asia. Through this open connection drift ice is therefore yearly transported across the unknown Polar Sea. On this same drift ice, and by the same route, we will put our expedition, and come on this side of the Atlantic."

But Dr. Nansen never went that way.

The Gulf Stream which enters the Polar Basin by the west side of Spitzbergen is warm salt water, and as soon as it meets the fresh water of the Polar Basin it dives under the fresh water and ice, and goes north until it has lost its vitality. What do you think of a basin filled from so many sources? The water must find its own level somewhere. Well I will tell you the Polar Basin Level is higher than the Pacific Ocean and the Atlantic Ocean; some of its cold water goes towards the Pacific Ocean, but the greatest part towards the Atlantic, finding its way between the Parry Islands, through Robeson Channel, and between Greenland and Spitzbergen, which brings us a quantity of polar ice and icebergs from different sources, and also a fine healthy air that we enjoy in summer, for the Polar Basin and its tributaries are the healthiest part of the world.

If you will permit me I will show you on the screen the state of the ice all round the Polar Basin and Greenland as seen by some of the most celebrated arctic explorers.

In April, 1827, the British Government appointed Capt. W. Edward Parry to carry out an expedition to the North Pole by way of Spitzbergen, it having been reported by whalers that there was a vast opening in the sea to the north-west of Spitzbergen in summer. Capt. W. E. Parry tried to reach the North

Pole by that route; putting his ships in shelter at the Seven Islands, he fitted out two boats 24 feet long, each weighing, with their stores, 3,058 lbs., and manned by 14 men. He proceeded to the north at a good speed, but finding the currents against him and making poor progress, although doing remarkable work, he decided to return after having reached 82.45 north. This is an example of working against nature.

On October 14th, 1871, Capt. Tyson and a party of 19 others were separated from the U.S.S., "Polaris" in about latitude 78. north. Unable to regain their ship the whole party remained on the floe and accomplished one of the most wonderful journeys on record. After a drift of some 1,500 miles in 195 days, they were finally rescued on April 30th, 1872, by the sealing steamer "Tigress" (Capt. Isaac Bartletts of St. Johns), in about latitude 53.35, north.

THE REMARKABLE TRAVELLING OF ICEBERGS.

Here, the lecturer pointing to the diagrams he was exhibiting, said,

This iceberg is about 400 feet high and is now leaving the glacier in Greenland.

This iceberg is about 450 feet high, we can see that by the height of the vessel's masts.

This iceberg near Disco is on his way south, and we can see the field ice at his foot.

This little iceberg is on the Bank of Newfoundland and as the waters of the Gulf Stream are melting it, it will soon disappear out of sight.

In 1875 and 1876, Sir Geo. Nares, Commander of the English Expedition through Smith's Sound and Robeson Channel.

Sailed on the 12th May, 1876. Here we see,

Chart of Davis-Strait, and route from England.

Ship "Discovery" leading through the ice in Robeson's Channel.

Ship "Discovery" left at winter quarters in Franklin Bay.

Capt. Stephen of "Discovery" Lieut. (now Admiral) Markham and Dr. Moss.

Ship "Alert" nipped off Cape Beachy by an ice jam.

Ship "Alert" off Cape Union, and during the spring, 1876.

Ship "Alert" in winter quarters.

Push for the Pole with sleighs with the party of 17 men commanded by our friend, Admiral Markham.

The Sea of "Ancient Ice."

Admiral Markham and a few of his men planting the flag in 83.20, north.

Map showing the high point reached by Admiral Markham, and the new coast line discovered.

This constituted one of the best equipped expeditions that was ever planned to reach the North Pole; but it was fighting against nature and when Sir George Nares said to Admiral Markham—"How old is the ice?" he replied—"Well, it may be 50, and it may be 500 years old."

This indicates that it is very ancient and constitutes part of the nearly stationary ice, and the fact of constant pressure upon the Greenland Coast was established for ever.

Here we see,

Lieut. Peary, and Mrs. Peary who followed her husband as far as Franklin Bay.

In 1892, Lieut. Peary's plans for reaching the North Pole by Greenland.

Sledge used by Lieut. Peary while he travelled across Greenland. I see that he utilized Nature as well as other forces, and he says that the coldest place in the Polar Basin is on Greenland at the elevation of 8,000 to 9,000 feet.

Lieut. Peary's new plan for reaching the North Pole. I must give Lieut. Peary the compliment he deserves; he is persevering, courageous, and made of the right stuff for an arctic explorer; but I am sorry he took the wrong way to the North Pole, for he has no help whatever from Nature, and the Esquimaux will never be induced to follow him where there is no animal life,—these children of nature will not venture where they cannot get their living.

This picture shows the state of ice in Mr. Walter Wellman's march to the North Pole off Franz Joseph Land on leaving in 1898.

The Duke of Abruzzi's voyage, reaching 86.33, with sledges and boat, shows that the ice is traversable in certain times during part of the year, also the open water on the west side of Franz Joseph Land, which was also proved by our friend, Mr. Frederick Jackson and Harmsworth's expedition.

While we are in the Arctic regions, let us look a little at this.

Map with regard to wind-drifts and currents.

Antarctic.

I will give you my experience in this part of the world as regards wind and currents. From Cape Horn to Cape of Good Hope, the wind and current prevails from the west, from the Cape of Good Hope and around the southern coast of Australia, the wind and tide prevails from the west, and from the southern coast of Australia to Cape Horn, again the wind and tide prevails again from the west, therefore the wind and tide goes round the outside circle of the Antarctic, so that we in our voyages to these different parts take good care to use favorable wind and current, and we always run our eastern down as far south as possible, so all sailors believe in being helped by nature; one frozen in the pack of ice will drift to the east.

Let me illustrate to you the work of nature outside of the Polar Basin by wind-drift.

This chart shows the wandering of the derelict schooner "Fannie Wolston" in the North Atlantic, from October 15th, 1891, to October 21st, 1894, after having drifted from the prevailing west wind to nearly the Azores, then to the south she came back to the west with the Trade Winds, then to the north of Hatteras, having been sighted five different times by different ships and reported; this constitutes part of the work of Nature which I advocate.

The voyage of the "Jeanette" constitutes my first chain of evidence of the work of Nature in the Polar Basin.

Since 1878 I have been deeply interested in arctic voyages, and I have followed closely this expedition. The "Jeannette," formerly named the "Pandora" left San Francisco after being restrengthened on the 8th of July, 1879, for the North Pole, by the Straits of Behring.

Capt. De Long. I give him credit for the route that we have now before us in which consists the first link of work of Nature. Capt. De Long was a young man of remarkable perseverance, he proved it in a letter that he wrote to Mr. Gordon Bennett, proprietor of "The New York Herald," who sent out the "Jeannette."

He says the current will take us north the same as the whalers, but it will be more difficult to get back. This shows

us great courage on the part of Capt. De Long, to leave for a place from which he could see no way to get back.

The "Jeannette" was beset in the ice of the 7th of September, 1879, and from that date Nature had charge of the "Jeannette" until she was crushed by the ice pressure on the 11th of June, 1881. Chief Engineer Melville's boat, landing on Henrietta Island. Capt. De Long and crew left the ship on the 12th June, with five boats and nine sledges, and after 104 days of hard travelling, two boats succeeded in landing in the River Lena.

When the "Jeannette" sunk, some relics were left on the ice, and strange to say, these relics were found some 2,900 miles away from where the "Jeanette" sunk, at Julian Head, some three years afterwards. These relics must have travelled at the rate of about 2 miles per day and this is in accordance with the last 3 months of the "Jeannette" drift.

If the crew of the "Jeannette" had saved provisions enough and stopped on the ice they would have drifted to Greenland the same as the relics.

SECOND LINK OF DRIFT.

Here we see Dr. Nansen, to whom we owe a deep debt of gratitude, and Capt. Otto Sverdorp, with the "Fram."

A vessel especially built for Arctic exploration, she left Norway June 25, 1893, and entered the "Kara Sea," sailing along the coast of Siberia as far as the New Siberian Islands, and the 21st of Sept. of the same year the "Fram" was made fast in the ice in latitude 78° 30′ North. From this time the "Fram" was frozen into the pack ice, and Nature drifted her across the Polar Basin towards Greenland, at about North 36 degrees West, in a little less than three years.

On the 14th March, 1895, Dr. Nansen and Lieutenant Johansen left the "Fram" with twenty-eight dogs and three sledges, to go to the North Pole, some 360 miles distant.

Here Capt. Bernier pointed to the following diagrams and pictures:

This shows us the state of travelling in that part.

Dr. Nansen, furthest north, 86.14.

The temperature monthly.

The mean temperature of the twenty-four hours.

Arriving at Franz Joseph Land in Kayaks.

Meeting of Dr. Nansen, with Mr. Frederick Jackson.

The state of the ice during October, 1893.

This illustrates the work of Nature helped by Science.

The combined experience of others who have ventured in the Polar Regions teaches us precisely what the conditions are that we have to cope with, and how they are to be overcome and I maintain that we now know that the Polar Regions can be surveyed, and the Pole reached.

Since the Fram returned, certain weaknesses have been discovered in her forward deck, and in her steam power. I have decided to increase both my steam and sail power. I do not intend to use full steam power until we get into the ice, when I will use the steam to force the way to the North. I intend to increase the resistance of the vessel by adding another row of beams all along the ship. The main beams will be level with the ice, so that the pressure will be carried on the main beams. I will also strengthen the engine room by the addition of some temporary beams, and also by some fixed beams. I will burn four and a half tons of coal, as compared with the Fram's four tons, and with that I will be able to get more power when needed. We have to be very saving of our coal, because four years is a long time. We will have a distiller connected with our cooking stoves, so that we will be able to distil salt water, in order to obtain fresh water, when we have not got snow to melt. And even the snow has a certain amount of salt in it. We will have a good deal of condensed food for our sleigh expeditions. My intention is to endeavor to reach the Pole by sleighs and small boats. The boats will be portable boats, similar to Nansen's, but improved. The sleighs will be built for carrying oil and will be non-sinkable. Each one will be a combined boat and sleigh, and when there is wind, we will utilize sails on them.

I think I could reach the Pole in one season and come back the next, but I do not approve of the route I should have to take, because no scientific results would follow. I put this statement before the public because it was thought that three or four years' absence was too long. The answer to that is that it could be done in a shorter time, but the necessary results would not be obtained. Since this short route was first spoken of it has been tried by Mr. Wellman, and by the Duke of Abruzzi, and now our American cousin, Mr. Evelyn Baldwin, is making an attempt on similar lines; and if he is prepared to spend the whole year there is no doubt he may reach the Pole.

I intend to take a crew of fourteen men,—including scientists. Fourteen men can handle the boat until we reach the ice and after we get to the ice there is no navigation to be done; the only work then will be to get in the leads, to cut channels and to keep the vessel free from ice. The first year we will have nothing to do but to keep the ship free from ice, and prepare her for wintering and look after her generally; at the same time taking soundings and whatever observations there are to be had. I intend to take photographs to show the formation of the ice; of the aurora borealis and of the moving ice. We will also have a graphophone to register noises made by the ice and at the same time register the noises made by any one of our party who gets in the blues, so that later, when we come back, we will be able to say, Mr. So and So on such a date had the blues. By doing this it is altogether likely no one will have the blues.

PLAN OF PROPOSED EXPEDITION.

Approved by the Quebec Geographical Society.

I propose to build a special vessel about 300 tons register, and to have a party of scientific men, and the best seamen obtainable.

Guided by the experience of Capt. De Long, Dr. Nansen, Prof. Nordenskjol, Prof. Baron Toll, Sir Clements Markham, and other eminent men of England and America, I believe that we can undertake this voyage with certitude that the result will be of some benefit to our fellow-men, and to science and commerce in general.

We hope to sail from Vancouver or Victoria, calling at St. Michael, or Port Clarence, to send our last dispatches and take in the balance of our stores.

Entering the Strait of Behring in about July, following the Coast of Siberia, and entering the ice between 170 to 165 degrees east as its state may permit, we will push north as far as possible in August and September, dropping buoys with records at intervals to test the ice drift. We propose to send one small balloon messenger every month with records, when the wind suits, so that the world at large may get news of the expedition. Every balloon will have a copy of the records sent in the former balloons. All possible photographs of everything we see will be taken, using kites for taking long distance-photos, so that we can see in fine weather the leads. Soundings, dredging, and other scientific observations will be recorded.

Once in the hands of Jack Frost, we would prepare for the worst; with suitable appliances, it is known that we can run long distances on the packed ice, during its proper season.

In our second spring and summer we would make two different routes, one in the north-east direction, and the other in a south-west direction, with stations at different places, so that we can keep in communication with the ship with wireless telegraphy and gun-signals when weather permits. These two different routes will be staffed at every mile. The staffs will be hollow, and part of them filled with condensed provisions, each one bearing a number and record, so that the passage of each party will be recorded. At the 50 mile station, soundings and weather records will be taken at intervals, and other observations.

When in the neighborhood of the Pole, the N.E. route will be extended to one or two more stations, as we may require, always being in communication with the ship and the stations. In this way I think we can reach 90 degrees North with certainty.

We know that dogs are the horses of the Arctic, and we shall have a small number of them, just sufficient to haul our material and stores. Having three years before us, we may count on a natural increase in the number. We must have also several boats.

A boat in section in case the ship will be lost.

But some of these boats are small and portable, so that they can be used for crossing openings, which are many sometimes, but as we are not in a hurry we can take our time to get along. We know we have our ship to fall back upon at any time when necessary. In all directions in which man has penetrated to the uttermost northern point of the north he has met the sea.

Will Great Britain and Canada reap this fruit, or shall we allow other countries to anticipate us ?

It is Canada's most northern limit, and we are bound in our own interests to attempt it.

We Canadians are willing to sacrifice a good deal and I hope will undertake it.

What we learn from the Mother Country we are ready to return with interest, and what a grand voyage it would be to start from Canada via the North Pole to England, coming back with a precious cargo of records of the unknown part of the Polar regions.

Our friend, Commander Scott, with the "Discovery" will do the same in the Antarctic Sea. If I turn my back to Capt. Scott on leaving, I hope it will only be for a short time when we shall meet again, each with a fine record.

I must say here, that in 1896 I proposed two plans. Plan No. 1, by the Strait of Behring, and Plan No. 2, by Franz Joseph Land to the Pole, and returning to Spitzbergen, but the Quebec Geographical Society preferred Plan No. 1, because it would bring better results.

To quote the words of Sir Clements Markham, President of the Royal Geographical Society before the Royal Geographical Society, London, May, 1897.

"There is, however, still much to learn. An expedition should be sent up Jones Sound to connect the 400 miles between Prince Patrick Island and Aldrich's furthest, and to examine the line of ancient ice in that unknown region. Another expedition should complete the examination of the northern side of Greenland. A third should be equipped on Nansen's plan, and sent to carry out Nansen's principle, by commencing the drift much further to the eastward, and passing over the Pole itself. This would probably occupy 4 years, but it would bring back a further instalment of knowledge of the vast unknown area and another series of magnetic observations. It should also decide the question of the existence of land between Prince Patrick and Wrangel Islands. It is true, therefore, that much remains to be done. Still, we have a large mass of facts respecting the Polar regions, from which scientific deductions may be drawn, and this has been enriched and materially increased by the labors of Dr. Nansen and his gallant companions."

In May, 1898, Dr. Nansen proposed a new route to reach the Pole and described how the Pole will be reached going by the Strait of Behring, by commencing the drift more to the eastward.

Allow me to give you a few views relating to your humble servant.

Here is the old City of Quebec, at one time the cradle of shipping in Canada, and so well represented at the Federal Government, by our Premier, Sir Wilfrid Laurier, and the Hon. R. R. Dobell, and the Honorable Solicitor-General, Mr. Fitzpatrick.

Next, my house in Canada—but let me tell you the home of the sailor is the sea, and he should be at home and contented everywhere.

Your humble servant's library at home.

"Man proposes, and God disposes." No matter what his rank or position may be, the lover of good books is the richest and the happiest of the children of men.

Having left home at the age of 12, I had not the opportunity to learn very much; finding that I was at a discount with my fellowmen, I made up my mind to study and pay for my own learning. I am very ignorant yet, but I mean to learn more.

"Knowledge, the wing wherewith we fly to heaven."

—(Shakespeare).

I am lured by no hope of gain, influenced by no spirit of conquest, but I am moved solely by the belief that man should know even the most desolate regions of his abiding place, the earth, and with the determination that the British Canadians shall do their part.

The globe is a chartered ship for the future, and richly loaded. The earth was made for man to utilize for his own good, and God gave him his own free will to go where he likes. Some men stop on the way, some go farther and farther, and it is a race to see this earth and to find our wants and pleasures.

My Motto:—

"Aime Dieu et va ton chemin"—"Love God and go thy way."

The greatest part of our knowledge comes from the Mother Country and old Europe; you can see the sun rising in the east, that means knowledge. "If we studied nature more we would succeed better." For everything on earth is for us. We have only to help ourselves and make the best of it, and the unknown Arctic area is well worth the having for purely practical purposes if for no other, because the available wealth of this northern world is by no means exhausted.

With your kind permission I will show you, so that you can know me better, a sketch of my forefathers which will show you that the spirit of the Navigator has been thoroughly instilled into your humble servant.

My grandfather (Capt. J. B. Bernier), at the age of 86, having commanded over 50 years.

Jean-Baptiste Bernier, a pilot for 53 years in the River St. Lawrence, at the age of 80.

Capt. Joseph Bernier, at the age of 71, was master for 40 years.

Capt. Louis Bernier, at the age of 60, in command of the Revenue Cutter, "La Canadienne."

Captain Thomas Bernier (my father), at the age of 70; he was master for 43 years.

Capt. Joseph E. Bernier—your humble servant. Master of the Deep Sea Vessel at the age of 17.

Your humble servant who has undertaken to sail from the Strait of Behring towards the Atlantic, for a scientific voyage, and to attain the highest possible latitude. I now offer my services to Canada.

Mr. President, allow me to thank you most gratefully for having honored my lecture by your presence.

Gentlemen of the Association of Ontario Land Surveyors, I also thank you for your kind attention.

Mr. President and Gentlemen of the Association of Ontario Land Surveyors, I thank you for the privilege you have given me of addressing you to-day, and for the sympathetic and intelligent interest you have shewn in the subject on which I have spoken.

[*This Association is not responsible as a body for any opinions expressed in its Papers by Members.*]

LEVEL OF LAKE ERIE.

BY F. W. FARNCOMB, O.L.S., LONDON.

The necessity for increasing the safety, certainty, and facility of the navigation of the Great Lakes and the Deep Waterways between them and the Atlantic tide waters, is one of the great undertakings of international importance which will require the immediate action of the Canadian and the United States Governments. The comparatively great variation, both annual and periodical, in the height of the water, in Lake Erie alone, involves enormous loss to the shipping interests as well as the expenditure of millions of dollars in deepening harbors, channels and waterways.

How to regulate or minimize this variation is the subject of a special and exhaustive report by Mr. G. Y. Wisner, a member of the United States Board of Engineers on Deep Waterways, from data gathered by this board, and endorsed by his colleagues, as a preliminary report upon the whole subject to be investigated, for which the necessary data and conclusions have not been completed. Records taken at Cleveland since the year 1865, up to the year 1898 inclusive, show that the mean elevation of the water in Lake Erie above mean tide at New York is 572.4 feet, and using the same datum, the highest mean monthly water mark, which was reached in 1876, is 574.3 feet, and the low water mark, reached in 1895 and 1896, was 570.6 feet. The greatest variation in the height of the water in the last thirty-five years was therefore 3.7 feet, and the mean annual variation, which continues about the same in recent years, is about 20 inches. The chief source of supply to Lake Erie is drawn from the great lakes above, which, with their respective watersheds, include an area of over 150,000 square miles, or about six times the area of Lake Erie and watershed; it is therefore the fluctuation in the supply from these lakes due to varying rainfall, ice, etc., which practically governs the variation of its water level. The flood water, pouring into the upper end from the Detroit River, the lake water at normal height must rise until the sectional area and slope of the upper portion of the Niagara River, which forms the outlet, is increased till its

capacity is equal to the increased supply from above, when the lake water level becomes once more stationary until the conditions are again changed.

It is evident that no matter what system be adopted for regulating the water to a uniform height, or in other words making the discharge equal to the supply, that the capacity of the Niagara River must be increased below the required lake level so that it will at all stages be sufficient to carry off the maximum supply. It is also evident that this can only be accomplished by deepening or widening its bed for a certain distance, or by raising the water in the lake above the river bed until a like result is obtained. With this result accomplished, by either method, means must be devised to regulate the discharge into this huge tail race, when its full capacity is not required, so that it will equal the volume of water flowing into the lake. This can only be done by means of a dam and flood gates in either case. For economical reasons alone, therefore, the scheme recommended for raising the water to or near high water mark, seems to be the proper one, apart from all important questions of the actual height which will be most convenient and beneficial to the majority of interests that will be affected.

By means of accurately measured cross sections of the river and careful observations taken at different stages of the water level, the volume of each mean monthly discharge from the lake has been accurately determined from the year 1865 to the year 1898 inclusively, and from these results the necessary height of the proposed submerged weir and width of sluice gates have been calculated, which fixes the height to which the water will have to be raised and maintained at 574.5 feet, or a little over 2 feet above the mean elevation and about 2 inches over high water mark for the period referred to, which was reached in the year 1876. The location chosen for the proposed fixed weir and sluices will follow a rock reef which extends into the river from the break-water of Black Rock Harbor, Buffalo, for a distance of about 1,300 feet and then deflecting about 35 degrees northerly, and running in at right angles to the Canadian shore, a total distance of 2,810 feet. Of this 1,600 feet will be a fixed weir, 1,040 feet will be sluice openings, and the remainder will be taken up by sluice gate piers. About 1,200 feet of the reef will be utilized at a small cost for the proposed weir as it is about the required height, viz.:—6.6 feet below the surface of the water when regulated to the height proposed. The river bed deepens suddenly at the end of this rock, and it is from there the piers and

sluice gates will be placed. They will be 13 in number, 80 feet each in width, and have a depth of 20 to 24 feet. To each gate will be attached suitable hoisting gear, and counter weights so arranged that the variation in weight due to immersion will be so equalized that the hoisting gear will only be required to overcome the friction, etc. So nicely will this adjustment be made, that it is stated two men only will be required to operate each sluice and the whole system will be opened in three quarters of an hour. The piers, 52 feet long and 12 feet in width will be built of concrete faced with granite, and paving stone will be carried up 9½ feet above the water and upon these the steel superstructure, 40 feet in height, to carry the weights and hoisting gear will be placed. The weir will be made with concrete, 5 feet wide on top with rounded crest with upper side sloped one to one, the lower side vertical, and both sides filled in with large stones. The foundation is upon rock-bottom throughout.

In calculating the discharge in the last 35 years, it is estimated that the mean monthly discharge was 220,430 cubic feet per second, and the greatest mean discharge for the first six months (which occurred in 1876), 285,200 cubic feet per second. The volume of discharge over the weir with the water at 574.5 feet will be 113,400 cubic feet per second, which can be increased at will up to 159,500 cubic feet per second by opening the sluice gates and making the total discharge 272,900 cubic feet per second, exceeding by 1,900 cubic feet per second, the average supply for the storage season for any year excepting 1876. But it is pointed out that in the last 6 months of the year the discharge was 60,000 cubic feet per second less than the capacity of the proposed regulating works, which could then have lowered the water one foot in two months, and that this contingency, as well as those in the future, could be readily dealt with by lowering the water sufficiently during the season of limited supply, after navigation closes.

In conjunction with this work a channel and lock will be necessary on the Buffalo side of the river to a point below the gorge where it widens and the current is slower, in order that vessels may pass around the works and at the same time do away with the present dangers and difficulty in navigating the shoals and swift current in this part of the river. The estimated cost of the regulating work is about $800,000, while the cost of the 17 foot channel and lock, 600 feet by 60 feet by 21 feet, is estimated at about $1,600,000, or about $2,400,000 in all. The probable effect of the proposed works upon the lakes and waterways above

and below is also one of great interest and importance. Perhaps the latter is more particularly so to Canada, for any further lowering of the waters of Lake Ontario and the St. Lawrence River would almost amount to a national calamity. While the report is not conclusive upon this particular point, the investigations in that respect not having been completed, it is claimed that regulation will not materially change the annual discharge through the Niagara River, and will only modify the distribution of flow about 5 per cent. of the average discharge, and therefore cannot materially affect the level of Lake Ontario and the St. Lawrence.

It seems that through the deepenings of the channels of the St. Clair and Detroit Rivers in recent years, the low water levels of Lakes Huron, and Michigan have been lowered one foot. It is estimated that the direct result of raising the level in Lake Erie 3 feet will be a corresponding rise of 2 feet in Lake St. Clair and one foot in Lakes Huron and Michigan, thus restoring to the latter their former natural low water level previous to the year 1886, and at the same time diminish the fluctations of these lakes one foot. It is shown also in favor of this scheme that the aggregate cost of improving Lake Erie harbors alone has averaged $1,000,000, for every foot in depth of permanent improvement, and also that the enlargement of the navigable channels of the St. Clair and Detroit River to a width of 600 feet, is at present a matter of urgent necessity, and the favorable effect that the proposed work would have in this instance also is apparent. The report states that the stage at which the lake level would be regulated, that is with an elevation of 574.5 feet above mean tide water, would be 6 inches below high water mark, but the date upon which this height was reached does not appear to be given.

DISCUSSION.

Mr. A. R. Davis:—I think we are deeply indebted to the writer for this paper on a subject that has arrested the attention not only of our Engineers but of the American Engineers. The Deep Water Ways Commission, composed of eminent Engineers has been looking into the matter of the water levels of the Upper Lakes now for several years. And we know that the canal at Chicago has been a question of grave fear on the part of the Engineers in reference to the levels of the Upper

Lakes. We hear now that the complaint of the people on the Mississippi River is that the sewage of Chicago is being carried down the Mississippi and is very gravely interfering with the purity of the water. That of course indicates the drainage of the waters of the Upper Lakes to the westward and southward.

An important question with us here is the level of Lake Ontario. If a dam is thrown across the Niagara River it will interfere with the discharge to a greater or lesser extent and consequently with the levels of Lake Ontario. The writer of this paper points out that difference in discharge is going to be very slight. I think he says it would be only some five per cent. I cannot see why such a discharge should be allowed if it is thought necessary to construct a dam there of such magnitude.

This is a question we are all concerned in, and we are indebted to the writer for giving us this very able paper; and I

Mr. H. H. Gibson:

There is one point mentioned by the writer of the paper that I would like to speak of. He says that Lake St. Clair, Lake Huron and Lake Superior—and I suppose Lake Michigan—would be raised one foot each in their level. Can any one here explain how it could occur, that the level of these Lakes which run into Lake Erie with a fall from each river would be raised.

Mr. A. R. Davis:—He claims that by raising the level of Lake Erie three feet at the bottom you would raise the level of Lake Michigan one foot.

Mr. H. H. Gibson:—Is there only that much fall in the River ?

Mr. A. R. Davis:—That is the inference.

Mr. H. H. Gibson:—Yes, but I thought it was more than that.

President Ross:—This paper is founded on a preliminary report only. The Deep Water Ways Commission has been taking soundings and obtaining information, and are doing so still, since the date given here of this preliminary report. I have seen them myself at work there with a tug in the River. This report deals with what is called damming the Niagara River, a thing which people many years ago thought was a preposterous proposition. When the final report of this Deep Water Ways Commission is published there will be a great deal more information given. One point that Mr. Farncomb has not taken into consideration,

this is, the action of the wind on Lake Erie. When there is a strong south-west wind the water is piled up there to the easterly end of the Lake, at Buffalo and all along the Canadian shore, and at Port Colborne, and towards the easterly end of the Lake. The water rises very materially, perhaps two or three feet; and then the Niagara River rises in the narrow places; just below the Falls, perhaps it will rise 15 feet in one heavy storm. This paper deals with Lake Erie as if it were a mill-pond that the wind did not affect very much. But the action of the wind really affects Lake Erie very considerably.

Mr. A. R. Davis:—Who is concerned in the construction of this dam ?

President Ross:—The Deep Water Ways Commission is a United States Government Commission. There was a joint meeting of Canadian and American Commissioners, but I think what is being done now is being done by the American Commissioner altogether.

There is another point that Mr. Farncomb has not touched on, that is, the damages that would have to be paid to the owners of lands in the vicinity of Lake Erie. There is a large acreage of comparatively low lands in the vicinity of Lake Erie that are only about three or four feet above the average level of the Lake; these lands are now cultivated and drained and if Lake Erie were raised nearly four feet vast tracts of land would be flooded and there would be quite a bill for damages.

The idea of raising the level of these Lakes is quite a good one; I suppose it is easier to raise the waters of the lake than to be continually deepening the waters of the harbors as has to be done in view of the fact that boats of much greater draught are being used now, boats of twenty feet and probably a greater draught have to come into our harbors. Port Colborne Harbor is being deepened now by the Dominion Government to a depth of twenty feet although the canals are still only fourteen feet in depth.

Mr. H. H. Gibson:—Was not the intention in building this submarine weir to raise it to a normal level, not to raise it beyond the original height that they suppose the lake stood at ? In that case there would be no damages.

President Ross:—I do not know about that; you might have to go back into the history of the lake.

Mr. H. H. Gibson:—I mean of recent times.

President Ross:—Not that anybody remembers.

Mr. H. H. Gibson:—I thought that was the intention all through the paper.

President Ross:—There is a great area of land now cultivated that could not be cultivated if the lake were raised; and the people who are making a profit off that land would be, I think, entitled to damages. However, that is a question for the lawyers.

Mr. H. H. Gibson:—They are probably using land that belongs to the Government.

President Ross:—No, this land is above the average high water mark. I do not suppose high water mark would mean the highest level.

Mr. H. H. Gibson:—It would not mean flood water.

President Ross:—That is, water piled up by the action of the wind ?

Mr. Gibson:—Yes.

President Ross:—No, it would not mean that. Of course high water mark is very difficult to define.

[*This Association is not responsible as a body for the opinions expressed in its Papers by Authors.*]

SURVEYING BY PHOTOGRAPHY.

BY J. N. WALLACE, O.L.S., D.L.S.

Considering the fact that Canada possesses in the Rocky Mountains some of the most difficult country in the world to survey, it is strange that even amongst surveyors, there should not be a more general knowledge of the method known as photographic surveying, which is so well adapted to rugged districts. This method is of interest not only to surveyors but to photographers as well, for the latter can fairly claim that by its use surveying has been added to the already long list of sciences which are indebted to the art of photography. There can be little doubt that the general want of knowledge of the method is due to the mistaken idea that its practice is involved in mathematics. No doubt some effort is required at first, to realize the general relations of a photograph to the actual country, but the theoretic knowledge necessary for the practice of surveying by photography is not very extensive nor difficult for a surveyor to acquire. It must not be supposed that proficiency in the practical art is so easily gained, for its difficulties are such that natural aptitude and a large experience in the field are necessary to overcome them.

The use of photography for surveying purposes is much older than is popularly supposed. So far back as 1860, the idea was practically developed by Colonel Laussedat, but its use has been very restricted. Surveys to a small extent have been carried out in several European countries, notably in the Italian Alps, where the lower parts of the mountains have been surveyed by the plane table and the higher altitudes by photography. None of these surveys, however, approach the extent of the Canadian surveys. Under the direction of Mr. Deville, the Surveyor-General of Dominion Lands, who originated the use of the method in Canada, photographic surveys already have covered over 25,000 square miles in the foothills of the Rockies and in the mountains themselves in British Columbia and the Yukon. These were commenced in 1887 and have been ex-

tended almost every year since then. The foothills surveys include the area between the prairie and the Rockies, from Calgary southwards to near Macleod, covering about 2,000 square miles of country varying in altitude from 3,600 to 8,000 feet. These surveys are plotted with great detail, and are used in connection with irrigation works. About 20,000 square miles of the boundary country between Canada and Alaska have been surveyed in a preliminary manner, and besides extensive surveys along the railway belt in British Columbia, photography has been applied to the survey of part of the country forming the north boundary of British Columbia, and more recently to the survey of the celebrated Crow's Nest coal area.

The photographic method receives its best application in the survey of mountainous districts, for the very ruggedness of such countries, which proves a barrier to ordinary methods of survey, is itself an advantage when we use photography, as it affords stations from which commanding views can be obtained. The chief characteristic of the method is its ability to make a rapid record of the positions of inaccessible points, and hence the more inaccessible and numerous these points the more fully are its advantages developed. There are, however, cases where it can be well used apart from mountains, when we wish to make a survey of anything lying in one horizontal plane or nearly so, which can be overlooked from suitable stations. Such cases may occur in the survey of a rocky coast-line, the shores of a lake, the windings of a river in a deep valley, etc. In such cases, by means of the perspectometer instrument, we can deduce the horizontal plan from the vertical photograph very easily and rapidly.

In considering the general principles of photographic surveying, it may be well to first of all point out the relation existing between the positions of objects in a country, as seen from a camera station, and the positions of the corresponding points in the photograph. We may suppose a surveying camera, so levelled that the plate is exactly in a vertical plane, to be set up on some mountain peak, and a view to be taken of a range across a valley. We know that an image of the distant scene is formed, by the lens, at a distance behind it equal to its focal length, that is, on the sensitized plate. We also know that the points in this image are so situate that a line drawn from any object to the so-called centre of the camera lens and continued onwards will pass through the corresponding point in

the image. Considering a whole series of such lines drawn from the various objects through the centre of the lens, we may regard the image on the sensitized plate as consisting of the points of intersection on the plate of all the lines of sight from the centre of the lens to the objects in the landscape.

We may now suppose a transparent screen to be placed at a distance, in front of the centre of the lens, equal to its focal length, and to be exactly parallel to the sensitized plate. The eye placed at the position of the lens and looking through the screen would see the landscape as it were projected on the screen. Such a picture, being formed by the intersection of the various lines of sight on a plane parallel to the plate and equally distant from the centre of the lens, would therefore be exactly similar to the image on the plate. We could, therefore, replace the picture on the screen by superimposing a finished print taken from the negative. By imagining lines drawn from the centre of the lens to the print so placed on the screen, we can realize how it is that a photograph gives a graphic record of the different lines of sight to all the visible objects, as seen from the camera station.

In order to make use of this record we must have some basis to work on. In the case of every photograph, in addition to the known focal length, which is constant, we must know three things. Firstly, where is the horizon line, that is, where would a horizontal plane through the centre of the lens have intersected the negative while the photograph was actually being taken. Secondly, we must know where the axis of the lens (that is, "the line of sight" of the camera) intersected the negative. This is called the principal point and is always on the horizon line so long as the plate was exposed vertically. A vertical line across the negative through the principal point is called the principal line. These two lines quarter the negative. As the screen picture is similar and similarly placed to the negative, these lines will occupy similar positions on it. Lastly, we must always know the absolute azimuth of the line of sight of the camera for each exposure. While in reality the picture of the landscape is recorded behind the lens, it is much easier to grasp the general principles if we suppose it to have been recorded on the imaginary screen placed parallel to the plate and in front of the lens.

There are very many forms of cameras for surveying purposes, which may be roughly classified as those which are simply

cameras, and those which have in conjunction some means of measuring horizontal or vertical angles or both. The Canadian Camera is of the first class, so that it is always accompanied by a second instrument to measure angles. Generally a 3-inch transit fitting on the camera tripod is used, and angles are measured immediately after the views have been taken by simply replacing the camera by the transit, without disturbing the tripod. The camera itself consists of a plain rectangular box, with no focussing arrangement, being composed of a metal framework, surrounded by mahogany. It can be used, like ordinary cameras, either with the long edge of the plate horizontal or vertical. On two adjacent sides are a pair of levels at right angles, one of each parallel to, and one transverse to the line of sight of the camera. One pair is always on top and the other pair neglected for the time. When a plate is exposed it is pressed against a rectangular metal border in front of it. In this frame, appearing in every print as a black border, are four small nicks in the approximate centre of the four sides. These nicks are so placed that the lines joining opposite pairs are at right angles, and their intersection is at the principal point. The placing of these nicks to fulfil these two conditions is of the nature of a permanent adjustment, and will not be discussed here. With the nicks so placed, the camera can be levelled so that a horizontal plane, containing the axis of the lens, will pass through the nicks. The principal line must then pass through the top and bottom nicks. As the spirit levels cannot be adjusted in the usual way, being fixtures, it is necessary to find instead the position which the bubbles must occupy in the level tubes, when the two side nicks inside the camera are horizontal. The levels parallel to the line of sight have only one function, namely, to place the plate in a vertical plane, one level being used for each position of the camera. The position of the bubble in each of these levels when the plate is vertical is found, at the commencement of the season's work, by an experiment somewhat analogous to that by which the zenith can be found in an astronomical observatory. Having been once found, the bubble is always placed in the same position, and we know that the plate is vertical whenever an exposure is made. The position of the bubble in each of the transverse levels, when the nicks are horizontal, is also found once for the season's work. When the bubbles have been so placed at every exposure of a plate during the course of the survey, we know that the horizontal and principal lines must have passed

through the nicks, and we can at once so draw them on the prints subsequently made.

If the proper position of the bubbles were not known during the survey, we need only assume positions for each of the four levels. These being used throughout the survey we can subsequently, by an experiment, find the positions of the horizon and principal lines, relatively to the nicks for the particular placing of the bubbles used throughout, and then draw these lines in similar positions for all the prints.

There is therefore no practical difficulty in drawing these lines on the prints, for they are at once drawn in similar positions for all the prints. Their positions can, however, be independently checked for each separate print, if required.

The finished print with the horizon and principal lines drawn on it in their correct positions, may now be supposed to occupy the place of the screen picture in front of the camera lens in the field. Each point in the print is now exactly on the line of sight from the lens to the corresponding object. Every object whose image lies on the horizon line of the print has the same apparent elevation as the lens, and from the distances of the other image points above or below the horizon line, we can deduce the altitude of the object relatively to that of the station by the principle of similar triangles. By drawing verticals from each point to the horizon line, we have a series of points along that line which gives the horizontal angles between the lines of sight to the objects. The azimuths to these various objects would then be all known if we knew the azimuth to one. This is found, for each view, by setting up the transit and reading the angles to at least one prominent object in each view, such as an isolated peak, which can be recognized subsequently in the print. At the same time a reading being taken to one of the other triangulation stations, we have the azimuth of each of the "arientation" points selected in the views. When the print is made, we first recognize the point we selected in the field, and then draw a vertical from it to the horizon line. From the position of the foot of this perpendicular, relatively to the position of the principal point, we can deduce the azimuth of the principal point itself, by a graphic construction.

From what has been just said, the method of plotting the survey will be apparent. The triangulation and camera stations being laid down on the plan in the usual way, a line is drawn

from the camera station in the direction of the line of sight of the camera when the particular photograph was taken in the field. On this line a point is marked at a distance from the plotted station equal to the known focal length, and here a second line is drawn perpendicularly. This last line has now the same relation to the plotted camera station, both in distance and arientation that the horizon line on the screen picture had to the centre of the lens in the field. By laying off on it the same series of points as we obtained from the verticals on the horizon line and drawing lines from the plotted station to these points, we have a series of lines representing the azimuths to all the objects selected. The same procedure being gone through for a second photograph, taken at another station and including the same points, gives a second series of radiating lines. Corresponding intersections finally establish the positions on the plan.

The prints are enlarged in the linear ratio of 2.1 to 1, forming prints about 13 inches by 9 inches. In the metal border, surrounding the plate, the focal length is exactly marked off, so that, by this ingenious arrangement, this length is similarly enlarged when the print is made. It is really this enlarged focal length, or "distance line," which is used when plotting the plan, thus preserving constant the ratio between the distances apart of points on the negative and the actual focal length. The effect of enlarging a print is the same as though the screen picture was moved proportionately far away from the lens.

As the points are plotted by intersections of lines of sight to the same points from two stations, similar points must be recognized in two views. This matter of identification is easy or difficult according to the angle between the two lines of sight, the nature of the scenery and the quality of the photographs. When the relative positions of points in two photographs are much changed, the only way is to regularly follow similar ridges in each print, the identification of one point then leading to another, and so on. In this way many points can be recognized, which could not be done, if we proceeded in a haphazard way. Both the ability to select points capable of identification, and identification itself are largely extended by practice.

A sufficient number of well-selected points being plotted, the elevations of all or some are found relatively to the camera station, by the principle of similar triangles. The elevation of the station having been found by trigonometric levelling,

a simple addition or subtraction gives the absolute elevation. We now have the positions and elevations of the salient points, and proceed to draw the contours by interpolation for every 100 feet or 200 feet as the case may be. Plans of mountainous countries consist almost entirely of these, and the watercourses. Enough points cannot be accurately located on the plan to draw the contours by these alone. Whatever the method of survey, the smaller details must be drawn by estimation. For this reason, in judging different methods, a great advantage must attach to that method which enables the topographer to estimate most closely. Photography has here a great advantage over its rival the plane table, for by having two or more photographs showing the country from different points of view to which he can refer as often as required, the topographer can arrive at a very much truer knowledge of the details than when using the plane table, which is restricted to one point of view at a time.

On the other hand it is claimed that it is easier to contour details with the actual country before you than from a photograph. In this connection it must be remembered that what we see, when in the field, is little more than a perspective. It is by our knowledge of the laws of perspective (probably acquired unconsciously) that we derive nearly all our ideas as to what would be its horizontal plan, when we look at a view, whether the view is a landscape or the interior of a room. It is true it is difficult to represent on a horizontal plan what is presented to us on a vertical photograph, but it is also true that our own eyes can only see the projection in the field, and similar difficulties arise when contouring there. With a photograph, whose distance line equals the distance of distinct vision (about ten inches), the sizes of objects as seen in the photograph are the same as their apparent sizes when we look at the landscape itself. It is only in lack of brightness and definition and want of coloring that a photograph is inferior to the actual view.

It must be admitted that here we have perhaps the greatest objection to the photographic method of surveying, for it is not possible, in the present state of science, to obtain a photograph as clear as the actual view, and it is often difficult to get even good photographs at all. Beside the usual defects of all lenses, plates and prints, the defects of the weather are peculiarly trying to a surveyor. He must largely take it as it

comes. The weather may be bad for days, or it may occur that, after a laborious climb to some peak, the day, which promised well, may suddenly change, and the surveyor must either take the photographs under poor conditions or else lose a day. Almost any defect in the weather has a worse effect on photography than on natural vision, and so long as this is so, an objection can always be urged against this method of survey.

Unfavorable weather conditions are caused by want of sunshine, fog, smoke in some localities and the blue haze at high altitudes. The last is partly neutralized by placing an orange glass in front of the lens. This stops the blue light diffused by the atmosphere, so that the light which reaches the plate is that coming from the objects themselves and not that originating in the intervening air. Such a screen has the bad effect of markedly increasing the shadows, for objects in shadow are nearly entirely illuminated by the atmosphere and such light cannot pass the screen. The result is that a valley in shadow shows up poorly, unless the extreme limit of exposure for the bright lights is allowed.

The time of exposure is a difficult matter to decide, varying greatly with the light, the scenery and the altitude. The effect of a particular light on eyesight is not a good test of its effect on a photographic plate, especially behind an orange screen.

The Canadian Camera is carried in the field in a box also containing a dozen plates, the whole weighing about twenty pounds. Single plateholders are used, and the plates changed at night under a canopy hung from the inside of the tent. An arrangement by which plateholders could be re-filled in daylight would be a great improvement, saving the surveyor the alternative of having to come down to his camp in the valley each night, or else having to carry a special tent up the mountain. Cramer's isochromatic plates are used, 4¾ in. x 6½ in. By isochromatic is meant a plate which is sensitive to the different colors more in proportion to their illuminating effect than is the case with ordinary plates, which are almost entirely acted on by the non-luminous rays. Such plates give results more nearly approaching the effect of natural vision. The lens is a Zeiss anastigmat, consisting of two doublets, with an equivalent focal length of 5⅝ inches. The enlarged prints therefore have a distance line of about twelve inches, a little greater than the distance of distinct vision. The stop used is F 36, a

slightly smaller stop than No. 64 in the "Uniform System." The enlargements are made on bromide paper. On account of the small stop, the orange screen, and the slow plates, exposure is long, varying from fifteen seconds for a midday sun in June to as much as three minutes for a dull day later in the season. The scope of the lens is such that seven views give a complete circle, with a small overlap for each.

The preliminary triangulation work in a photographic survey does not greatly differ from that usually employed. The triangulation stations being on high peaks, usually afford good camera stations, and they in addition to others are so used. A sharp peak offers the best site. Flat topped mountains, especially if timbered, are very objectionable. If they exist only in isolated groups they may usually be surveyed from camera stations situate on more favorable neighboring ranges. It is a general rule that a ridge is not surveyed by camera stations on itself.

With regard to the distance which may be safely included in a view, this will depend on the state of the weather and the detail required. Speaking generally, sufficient detail for a good plan of a rugged country can be obtained if the points are not over three miles away. Greater detail would be unnecessary in the survey of rugged districts. The principal shoulders and the watercourses down the sides of the mountains can be well plotted from good photographs up to six miles. Beyond that we can only expect to obtain a general idea of the country. The position of the camera stations, however, is more often described by the necessity of seeing up valleys beyond intervening ridges, than by the question of how far the details can be made out. Every part of the country must also be covered twice, from two stations whose distance apart forms a suitable base. It must be remembered that although we may be able to see points in a photograph up to six miles, it does not follow that one camera station can survey a circle of six miles radius. Around each camera station there is always a large space too close to be surveyed. When points approach the base line between two stations, although they may be clearly seen in the photograph, the lines of sight to them from the two stations make too obtuse an angle to allow of proper identification. Identification, even with good photographs, is difficult and involves much loss of time if the lines of sight to the points intersect at a greater angle than forty degrees. The aspect of the country is

too much altered in the two photographs to allow enough points to be identified. If we imagine a segment of a circle containing an angle of forty degrees to stand on the line joining two camera stations, it is easily seen that the lines of sight to all points in this segment intersect at a greater angle than forty degrees, and the whole area of the segment is poorly surveyed. This area must be doubled for the two sides of the line. With camera stations distributed over a country at approximately equal distances apart of five miles or so, these unsurveyed segments may become very great, and almost neutralize any attempt at a detailed survey. Had the same total number of stations been placed in pairs, a couple of miles apart, with a much longer interval to the next pair, a very much better survey would result. This is a matter very apt to be overlooked in a photographic survey. It may be remarked that the absence of a record of what has been covered by the photographs taken is much felt in the field. Not only must the surveyor recollect what has been covered, but whether it has been covered twice from suitable stations, a difficult matter in a country whose aspect is much changed as we go from station to station.

The field notes of the photographic part of the survey consists of a record of the number of the plate exposed, the extent of country covered, the time of exposure, kind of light, and such remarks as may be useful. The magnetic bearing of the line of sight of the camera should also be taken by means of a pocket compass, as a general indication of the direction of the view for office reference.

The chief objections to the photographic method may be considered to be the difficulties of obtaining good photographs, the absence of record of what has been properly covered by the camera, the fact that the country must afford stations overlooking large areas, and finally that a long apprenticeship is necessary in the field to properly estimate exposure, and that advancement in the science of photography itself is necessary to perfect the method.

On the other hand, we have a much shorter time in the field, not only saving expense, but a matter of consequence in a severe climate, and a possibility of surveying countries containing many inaccessible points with greater detail than by any other known method. The fact that a rather long time is taken to plot from photographs is largely due to the camera stations not being suitably arranged to facilitate identification, and to

poor qualities of photographs, both of which impediments can only be avoided by practical experience.

As a practical example of the use of the photographic method of survey, some statistics will be given of the survey of the Crows Nest coal area, on which the writer was engaged last year. This area consists of a group of cretaceous mountains 6,500 to 7,500 feet altitude, surrounded by limestone mountains rising to 9,500 feet. The field work in this survey occupied three months with a party of six, all told, during which 51 triangulation stations and 72 camera stations were established and 336 photographs taken. Of the camera stations, 25 were over 7,000 feet and only 14 below 6,000 feet. The area plotted from the photographs covers 551 square miles, an area of over 15 townships. The contours are shown for every 100 feet, and considerable detail is shown, as the plan is on a scale of 1-30,000, or about 38 chains to one inch. The plotting occupied four persons for three months. The altitudes of the triangulation and camera stations were found by trigonometric levelling, using the levels along the Canadian Pacific Railway as a basis. With the exception of a few traverses of some of the rivers the entire topography has been plotted from the photographs. It may fairly be claimed that this large area of rugged country could not have been surveyed and plotted in the same time by any other method. The survey and plotting were carried out under the direction of Mr. A. O. Wheeler, D.L.S., who has been in charge of photographic surveys for the Dominion Government for the past six years.

In the foregoing outline, the writer has endeavored to give some general idea of the photographic method in the survey of mountainous districts, avoiding technicalities which can only be interesting to those who desire to study the method in detail. Such will find in Mr. Deville's work "Photographic Surveying," a complete account of its mathematical aspect and also a masterly review of the principles of photography itself as applied to distant scenery. Another excellent publication is Appendix No. 10, U.S. Coast and Geodetic Survey for 1897, by J. A. Flemer.

DISCUSSION.

Mr. C. A. Jones:—Are those photographs retained by the

Government or by the person who takes them ? The Government should have them, or copies of them.

Mr. Dickson:—I understood last year that ten parties had photographic apparatus and that they returned everything to the Department, even the films. Of course when the Government furnishes the apparatus it expects the results will belong to the Government.

[This Association is not responsible as a body for any opinions expressed in its Papers by Members.]

THE CANADIAN ASSOCIATION OF CIVIL ENGINEERS AND SURVEYORS.

A. R. DAVIS. B.A.SC., O.L.S.

A few years ago I had the honor of submitting a paper before this Association on the subject, "The Field of Civil Engineering."

At present I desire to glance briefly at the broader field of Civil Engineering and Surveying combined, in order to point out a few reasons why, in my judgment, these two branches of one profession should be consolidated into one Society or Association. We are all pleased with the fact that the tendency of late has been in the direction of a closer fraternal union between Engineers and Surveyors. As members of the Canadian Society of Civil Engineers, and of this Association of Ontario Land Surveyors, the thought presented itself to me that by frankly expressing my views on the subject at the present time, when we are stepping out into a new century, a general friendly discussion of the whole matter might possibly be provoked that would materially assist in bringing our Engineers and Surveyors into closer contact and ultimately lead to a corporate union.

In the first place I think we all realize that in the business world to-day, greater success is being achieved through judicious combinations of brains, as well as of material resources. Men are not disposed to hide their knowledge under a bushel, as in the past; but to diffuse it among their fellow-men. This spirit prevails too, in the professional world, where an individual realizes it is utterly impossible to isolate himself from his professional brethren even for a brief period, and still keep abreast of the times.

The tendency of the times is for each individual to pour his small quota of knowledge,—which is certain to be useful to some one else,—into common public reservoirs. These reservoirs are the periodicals and public meetings of the various departments of business, and the several professions. Then from the accumulated wisdom and knowledge deposited therein are drawn such

portions as each individual may require to meet the exigencies of the case, with which, for the time being, he has to deal.

As we are all aware, the medical profession has recently been engaged in breaking down old barriers of prejudice, widening the field of practice to the limits of the Dominion, and elevating the standard generally by a combination of its forces. The same tendency prevails in all the sister professions, including the one with which we stand identified. Civil Engineering and Surveying are complements the one of the other, not only in practice but in theory as well. Throughout the Dominion the two terms are, almost synonymous, and in fact, interchangeable, to those outside the pale of the profession.

A Civil Engineer in many departments of work is frequently called a Surveyor, although he may never have passed a Surveyor's Examination. The day has passed, however, when the Engineer feels any resentment at being called a Surveyor. He has doubtless found from experience that the modern Surveyor knows something more than how to take a meridian.

A Surveyor on the other hand is called an Engineer, by the public, immediately he ceases to run a side line and to take charge of certain drainage, sewerage, or other work. A railway company sends out a party of Engineers to locate a railway. The press in alluding to the fact is quite likely to state that "a party of Surveyors is surveying a railway line from A to B."

Thus we find it in practice. In theory we observe that the several departments of surveying form the most important subject in the curriculum of all the Civil Engineering faculties of our schools and colleges. On the other hand, the several Surveyors' Associations of our Dominion, are more and more recognizing the absolute necessity of compelling aspirants to the profession, to read up and pass examinations on a variety of subjects, which in the past were not regarded as essential in an ordinary Surveyor's practice.

These aspirants are forced to realize that it will be utterly impossible to even eke out an existence to-day as an ordinary old time country Surveyor, let alone to prosper, in his profession. Time was when the Surveyors of this country were kept employed the year round in private practice or Government employ. They usually owned a good farm, well equipped for work, and were regarded as important members of the community in which they resided. The land trials which then occupied the largest part of the attention of the courts invariably had Surveyors pitted against each other; and thus employment in the courts

was a fruitful source of income. The presence of a Surveyor as a witness in our courts to-day is the exception rather than the rule.

Hence the necessity for our young men who are entering engineering or surveying, qualifying themselves for profitable employment in the larger field of our profession, of which surveying is but a part, and of which engineering as heretofore understood is but one important division.

There is a broad field bounded by the Atlantic and Pacific on the east and west, and by the international boundary and the North Pole on the south and north, in which it should be possible for every duly qualified Canadian Engineer and Surveyor to practice where he pleases, none daring to molest or disturb. Now such a condition of affairs would necessitate a change, in some respects, in the government of the profession, and this is the vital point towards which we are aiming. For instance, in civil engineering, we find the deplorable condition of the laws of the United States rendering it practically impossible for a Canadian Engineer to find employment in that country without renouncing his allegiance to Great Britain, and declaring his intention of becoming an American citizen; while on the other hand our doors are left wide open for an influx of American or other foreign engineers immediately any work is started, promising profitable employment. We have had a glaring illustration of this fact during the last few years in British Columbia and other parts of our western country where there has been active railway construction.

These foreigners are not members of the Canadian Society of Civil Engineers, nor have they the remotest intention of becoming Canadian citizens. I believe in reciprocity; but I am thoroughly opposed to this jug-handled policy, as the politicians would say, and I shall do my utmost in the future to have this injustice remedied. Our Surveyors' Association would not tolerate such a condition of affairs for a moment; and I refer to it here merely to show that the Engineers as well as the Surveyors of this country have important changes to make in their regulations before a corporate union can be effected between the two branches of the profession. With regard to the several divisions of Surveyors, we all realize that a closer bond of union might exist than at present obtains; the absence of which necessitates needless examinations, the payment of additional fees, and a material loss of time. Through the influence of this Ontario Association, and kindred

associations, a more cordial and fraternal feeling prevails than ever before, between our various Surveyors and Engineers' Societies, and between the individual members. This *esprit de corps* has undoubtedly been generated and fostered through the prevailing practice of meeting as at present, on common ground, and in broadly discussing questions that concern our profession in a frank, genial manner. Our selfishness and conceit take wings and fly away in the midst of such surroundings. We learn to value the opinions of others although they may not accord entirely with our own. Thus knowledge is gained; and knowledge is power; and the more powerful we become in this sense the more prosperous and useful we will be in our respective communities. We should not rest satisfied, however, with what has been accomplished. A young generation of Surveyors and Engineers is coming up to take our places. As we look abroad we see changing conditions in this country, now in a transition state from dense forest, poor transportation and undeveloped resources, to broad cultivated areas, rapid transit to the remotest boundaries, and the hum of industry on all sides. One of the important results of these changing conditions, to our profession, is the absolute necessity of the Government immediately taking up the question of a thorough trigonometric or geodetic survey of Canada, in order that accurate maps may be prepared, and the physical features of the country laid down with precision.

It is surprising that our Federal Government and Provincial Legislatures, alive to almost every conceivable question affecting our development and prosperity, should remain fast asleep on this most important question, which is now occupying the keenest attention of the Governments of every progressive country in the world.

If a tithe of the millions of our money now being expended on canals, railway bonuses, and public works, were devoted to the beginning of a geodetic survey of Canada, in keeping with the general progress of the times, more wisdom would be exhibited by our legislators than they are manifesting by closing their eyes to so important a matter. It is most unfortunate that our profession is not more strongly represented on the floor of Parliament, and in our Legislative halls. Had we a few enthusiastic representatives, then our governments would soon realize the necessity of a movement in this direction, as well as in several other directions, in which our profession is more or less interested. Who is ready to

sacrifice himself for so laudable a purpose? A geodetic survey of Canada will create at some time in the near future a great field for the employment of our younger Surveyors and Engineers—a field in which they should meet on common ground, and for which our examinations and legislation should, meantime, pave the way for united, efficient work.

While the geodetic survey is in progress in the southerly or more densely settled portion of the Dominion, other Engineers and Surveyors will be engaged in explorations in the great northerly limits of our country; in the building of colonization roads into newly settled districts and the improvement of those in the older districts; the extension of electric railways through the south country, and the construction of steam railways into the timber, mineral and agricultural areas of the north country; and in the execution of large drainage and sewage problems. The Premier of Ontario in summarizing recently the results of the northern explorations of some of our Surveyors last year, and the known resources of the northerly part of this province, and the intentions of the Government with respect to the development of these resources, gives us a hint or intimation of the work in store for our profession in that heretofore practically unknown district; and Ontario is only a fraction of our great Dominion. Let us then be alive to our opportunities, and frame our legislation now so that it will conserve our best interests in the future. If our Engineers and Surveyors were united into one Society, and jointly attended the Annual Meetings, supplying general papers and discussions and if these proceedings could be placed in the hands of every member of the profession, what a library of useful information on every phase of professional work would be accumulated in the course of a few years.

I am aware such a union appeals more strongly to the younger Engineers and Surveyors than to the older ones; owing perhaps to the fact that the latter, as a rule, have settled down in certain comfortable grooves in professional life, out of which they may not care to move. So far as they personally are concerned the present laws or regulations governing their Association or Society answer very well. Many having acquired a competence have no sympathy with the so-called innovations of the younger members of the profession. It has ever been thus in all the avenues of life; and human nature is slow to change; but still changes are continually being wrought. Therefore I appeal particularly to the younger Surveyors and Engineers to support this

movement for the consolidation and elevation of our profession; for they must bear the burdens and responsibilities of the future.

I see nothing inconsistent in a corporate union of Civil Engineers and Surveyors, and the maintenance if necessary, of certain special examinations for special work, such as, for example, topographical surveying, or hydraulic engineering. The latter are chosen from several branches, simply for the purpose of illustration. I repeat, that there is no good or valid reason for objection to a corporate union on the ground that there would be no surveyors qualified for important special work, or, no Engineers trained to cope with the difficult problems of special branches. These questions would adjust themselves quite readily; and we would have the proud satisfaction of realizing that we have become a common brotherhood, bound together and strengthened by corporate and fraternal bonds for all future time.

I do not assume to know all the difficulties that stand in the way of such a union; nor how best to overcome them. Others, doubtless, will, in due time, give these details careful consideration, and suggest ways and means for its accomplishment. I have merely endeavored to show the tendency of the times toward internal consolidation in the various circles of business and professional life; and to make a few suggestions in favor of a forward step in that direction in our own profession. If what I have said is instrumental in drawing out the opinions of others, and leading to a general discussion of the subject, I shall have fully accomplished my present purpose, and will feel amply rewarded.

DISCUSSION.

The President:—Gentlemen, Mr. Davis has given us a very valuable paper on an important topic that I have no doubt all of you will take pleasure in discussing. What he says with regard to the qualification of surveyors and engineers is very true. Any young man now who is licensed, or who passes his examination as a surveyor, has passed an examination on many engineering subjects. In fact, he has practically to qualify as a civil engineer in order to become a surveyor. A year or two ago, the

Canadian Society of Civil Engineers proposed to allow all surveyors to become members of the Canadian Society of Civil Engineers for the reason I have just stated.

Mr. Willis Chipman:—Mr. President and Gentlemen: I do not know that I can say anything that would be of interest to you to-night on this important matter; a few years ago I was chairman of a committee having the matter in charge for the Canadian Society, to bring it before our Government; and we met with such a reception that I have not felt very enthusiastic over it since. However, it has been revived again this year by the Canadian Society, and we hope by next year that probably we will be able to report progress.

I, for one, am in favor of uniting the two professions. In this new country of ours we cannot afford to have a number of similar professions or societies where one society is enough. There might be different branches or different departments in the one society, as is suggested by Mr. Davis; I hope that the amalgamation of the two societies will be consummated in my day.

Mr. Villiers Sankey:—I thought I had a letter here that would partly answer one of the remarks which Mr. Davis has just made, but I am sorry to say I have not the letter with me; but I can recall the substance of it; and Mr. Van Nostrand can give us the answer that was sent to the letter I refer to.

This letter was from a gentleman in Winnipeg, who suggested that there were a great many examinations, and a great many fees to be paid by surveyors in the Dominion of Canada, and he thought that it would be advisable for us to meet on some intermediate ground, probably not a very high plane, that would be common to all the Provinces of the Dominion, as well as to the Dominion Land Surveyors. His idea was that a man having passed his preliminary examination, and having served a reasonable apprenticeship, should then be permitted to pass a final examination, which would qualify him as a competent surveyor in all the Provinces of Canada. In other words, make us all what the public thinks we are, Dominion Land Surveyors. I have been met with the question, "You are a Dominion Land Surveyor?" and when I have said "Yes," I have then been asked, "Then you can survey from the Atlantic to the Pacific?" My answer to that rather astonished my questioner, when I said, "I cannot." As a matter of fact, the amount of ground a Dominion Land Surveyor has a right to survey is rather re-

stricted; years ago, he could survey in Manitoba, but now he cannot. A Dominion Land Surveyor cannot survey in Ontario or in any of the Provinces. A letter on this question came to Mr. Van Nostrand before I became Secretary of the Association, and he answered it, in the only way he could answer it, showing that down in the Eastern Provinces the qualification for Provincial Land Surveyors is not at all comparable to what it is in Ontario, in Quebec or in Manitoba. Some years ago we were rather astonished to find that the Board of Dominion Land Surveyors would not recognize Ontario Land Surveyors at all; and at a recent examination in Ottawa they asked Ontario Land Surveyors to pass the whole examination.

While speaking of Examiners I am able to say on behalf of the Ontario Land Surveyors that ours is the broadest and the most open-minded Board of Examiners that there is in Canada to-day; under our recent Legislation it rests with the Board of Examiners to say whether the candidate will be required to pass the whole of our examination or part of it, and how much service he will be asked to undergo. We are not bound by any hard and fast rules or by any reciprocity with any other association either Provincial or Dominion. I do not think, to-day, even if the Dominion Board asked our members to pass the whole of their examination, that we would necessarily turn round and ask a Dominion Land Surveyor, to pass the whole of our examination. If we know the class of examination their members have passed and are satisfied with it, we are perfectly free to say, "That is good enough for Ontario!" And I do not think that the Surveyors of the Dominion can really say that we are behind other Surveyors in any point. The difficulty the Surveyors in the whole of the Dominion have in order to meet on a common plane is that some of the others are not quite up to our standard. I think, however, with proper representation, that any difficulties as to the preliminary examination and time of service could be easily over-come.

Speaking on the question of reciprocity with the Engineers, as Mr. Chipman and some others present know, we discussed that about two years ago; and as far as I was able to judge, the feeling of our Association was that if we could meet on a satisfactory plane we were quite willing to give the right hand of fellowship to every Engineer in the Dominion of Canada. The question was, what position were the Ontario Land Surveyors going to occupy in the event of amalgamation. After a great deal of discussion a mutual basis was established, and

I believe the Ontario Land Surveyors did all they could to help the Engineers to get their Bill through the Ontario House. But until the Engineers of Ontario get some status, some recognized position, an amalgamation will be difficult. If they can get their position officially recognized, I think the amalgamation would follow almost at once. The trouble seemed to me to be that the Engineers themselves were not united. They have to meet a great many difficult questions. There are all sorts of Engineers—I am not saying that in any way slightingly, but I suppose engineering, like everything else, has in its ranks a number of specialists. Possibly it may be said that some of these gentlemen are Engineers and others are not; but in the event of amalgamation the Ontario Land Surveyors cannot leave any one out if there is any possible way of bringing al' 'ogether. In engineering we find the Mechanical Engineer, the Railroad Engineer and the Municipal Engineer; and I am glad to say that our Association of Ontario Land Surveyors embraces some representatives of almost all these classes in Ontario. The City Engineers of almost every City of Ontario and the chief Engineers of such Railway Companies as The Canadian Pacific, The Grand Trunk, The Central Ontario and others I might mention are all regular members of this Association.

I think the paper we have just heard read points in the right direction; and we ought to nominate a special committee to try to further the objects brought before us. We are in a position now to do so, having an Association of some years standing, and having some little weight in the community. We have experience in the matter of getting incorporation; and it certainly would not hurt the movement if we were in a position to say, "We have a committee ready to meet you and ready to discuss the whole question."

I hope to hear some other members express their views; I know Mr. VanNostrand has some excellent ideas on the question of amalgamation with the other Surveyors of the Dominion. We need not be afraid of expressing our opinions here for while there are a good many Surveyors and a good many Engineers in the room, we are all here to-day as Ontario Land Surveyors, and the fact that this is a meeting of Ontario Land Surveyors ought not to hinder an Engineer who has strong views from expressing those views. We are not going to take advantage of any remarks that may be made here. As a Surveyor pure and simple I would say the sooner the amalgamation

of Surveyors takes place the better for the Association and the better for the whole profession; and, I believe also, for the public at large.

As Secretary of the Association probably I should not have taken up so much time, but I am afraid some of our members are a little bit shy so I wanted to start the ball rolling. (Applause).

Mr. A. J. VanNostrand (Toronto).—Mr. President: Some years ago I somehow got hold of the idea that it seemed rather foolish to ask a man who had taken the Dominion Topographical Certificate to come here and wade through the "Pons Asinorum" and a few more such things, and I opened a correspondence with the Secretaries of the various Provincial Boards, with a view to arriving at some sort of arrangement under which a man might pass an examination in the elementary subjects at least, before any one Board, and by reason of that examination be admitted by any other Board in the circle. The thing went along very well until I reached British Columbia; and there I got a private hint that their door was wider open than ours was; that, under their Statute, Engineers of various kinds were admitted on short terms of service; in fact persons were permitted to enter the profession of Land Surveying in British Columbia on much easier terms than those required by any other Board! As the Engineers did not seem to be in a position to offer any *quid pro quo* it seemed to me that it was about time to give up my idea and I did so. It still seems to me, however, that theoretically speaking it is not the part of wisdom to require each man to go over the same ground again if he happens to wish to take out certificates from the various Boards, Provincial and Dominion. Such, however, is the position to-day. And until the Engineers arrive at some stated form of examination I do not see how we, Land Surveyors, even supposing all Dominion and Provincial Land Surveyors had amalgamated, could come into association with them.

The Maritime Provinces, however, do not appear to have a standard in any way similar to our own for admission to the profession of Land Surveyor. So far as I can learn, a Land Surveyor there is a good practical man who is about as far advanced as a good timber estimater is here; a man with a little mathematical knowledge, and a little practical knowledge of surveying. And until their standard has been brought nearer to ours it does not seem to me to be a wise thing to amalgamate with those Provinces. As the writer of the paper suggested, all

things are trending towards union because the various Provinces are uniting and the professions of Engineer and Surveyor are kindred to such an extent that they are carried on by the same parties in many instances, and therefore, we ought to make some move. It would be a very good idea to have a committee appointed because if something is to be done this is a very good time to make a commencement. (Applause).

Mr. G. B. Kirkpatrick (Toronto):—Mr. President and gentlemen: When Mr. VanNostrand was speaking I thought of an old story told of the American War, where the standard-bearer planted his standard on top of a hill and in front of his men who called out to him, "Come down! Bring the standard down!" His reply was, "Never! Bring the men up to the standard." I do not think we should come down to a lower level than our own. (Hear, hear). We have been for years bringing our standard up; and we must keep it there. I say, just as that standard-bearer said, Bring your men up to our standard and then there will be no difficulty. I am quite in accord with the idea that it is nonsensical to make Surveyors pass the same examination over again. On that point I think our Board has taken the proper stand, that is, to keep the door open, without lowering our standards and to recognize that we are not the "whole bunch," to speak vulgarly. We have a standard which is second to none, but we are not going to humiliate men who have passed a first class examination in mathematical subjects, by asking them to go in again for a similar examination; we are quite satisfied, if they can present their certificates, to give them the examination. We must, of course ask them what their term of service has been, so that they should not militate against our own men as regards service.. We leave them free to take up the higher subjects which we have in our profession the curriculum for which, as you know, has been extended until it embraces almost everything that an ordinary Engineer has to pass.

There are specialists in the different branches of Engineering who occupy positions which it is impossible for the ordinary Engineers to attain to. The Engineers and the Surveyors who have passed within the last ten or fifteen years, are quite able to cope with the majority of engineering or surveying problems which arise in Canada to-day. Mention has been made here to-night of the chief Engineers of different Railway Companies; and as to those gentlemen let me say that they are nearly all self-made men; they did not attend College, they

did not pass examinations, but they had a broad knowledge of what the best Ontario Land Surveyors require and they had good common sense. They did not get into a rut. They studied their profession and they gradually rose by the force of their education and their abilities to be the head men in their respective Companies to-day.

As an example, I remember Mr. Hobson when he was an Ontario Land Surveyor—he is one still; when he was second engineer on construction on the Grand Trunk, on the next section to which I had the honor of being rod-man. Mr. Hobson was then a tolerably young man, and I do not suppose he had studied engineering very much; yet he has solved a problem which I suppose would be an example to the most highly educated. He was the Engineer of the St. Clair Tunnel at Sarnia. I remember when the two borings, one from each side of the River met, that there was not two inches of difference; that was pretty good engineering. There is no reason in the world why all our Surveyors should not work together for the benefit of our profession: and if having amalgamation between the Engineers and Surveyors is going to raise the profession I do not think the Engineers when they are ready for it, will find the Association of Land Surveyors are backward in joining them. When this matter was up before, I remember we made a very good advance; there was a deputation, amongst the members of which I remember Colonel Gzowski and Allan MacDougall, and some other Engineers, and we met them and discussed the subject, and there was no opposition on our part; there never has been. Our desire always was, not to be dragged down and put on a lower level than we stand on to-day. If the Engineers become incorporated, and then approach us in as friendly a spirit as they did before, I see no reason why we should not have amalgamation. (Applause).

President Ross:—I understand the proposition made two years ago by the Civil Engineers was that all Surveyors were entitled to become Civil Engineers; but there was no proposition to make all Engineers Ontario Land Surveyors. Is that correct ?

Mr. Sankey:—Yes.

President Ross:—Of course that was very favorable to the Land Surveyors, and very considerate of the Engineers.

Mr. Sankey:—I think you are stating it a little wrongly. It was, All Surveyors at the time of incorporation; not, All future Surveyors.

President Ross:—Yes, I understand that. With regard to the Ontario Land Surveyors becoming Dominion Land Surveyors, I was not aware that it was necessary for an Ontario Land Surveyor to pass the full examination. Of course it was some years ago when I qualified.

Mr. Sankey:—All I can say in answer to that about a week ago several members of our Association went down and passed their examination; and they were required to pass in everything.

Mr. VanNostrand:—Including certain preliminary examinations too.

Mr. Sankey:—They went through the whole academical and theoretical examination as if they were not Surveyors.

President Ross:—That was not required some years ago.

Mr. Sankey:—No.

With regard to Manitoba, they have the reciprocity clause in their Act which provides that they will reciprocate with any other Provincial Association and not require examination in anything but the special Manitoba Land Acts, as I might put it. That is, if the Association from which the Surveyor seeking admission will reciprocate with them. The question has been asked me, and the answer I have had to give is, We have no reciprocity now at all; but if the Manitoba examination is in the opinion of the Examiners sufficiently similar to ours we will not examine at all except on the Ontario Survey of Lands and Drainage Acts; and if their term of service is sufficient we would not ask them service. That seems to be the position we are in to-day. But we could not write to a man and say, We will reciprocate with Manitoba if Manitoba reciprocates with us. If the examination is good enough in Manitoba, reciprocity or no reciprocity, Ontario should say, Your examination is good enough for us; pass the special subjects and we will give you a certificate. Reciprocity does not amount to anything; it is merely a motion of the Board of Examiners for the time being. The Dominion Board a little while ago—(I do not know what happened them)—simply wrote and stated they would not recognize Ontario Land Surveyors in any way; and now they examine our men in everything. Are we going to say to the Dominion if their men come up here, We are going to examine you in everything? I hope not. We know their Examiners are clever men and that they put their candidates through a stiff examination. Then why should we say because

you examine our men, we will examine yours. If we are satisfied with the man's standing it is better not to examine him at all; it costs the Association something every time we examine a man, and it is better to get good men without examination, except in subjects which are absolutely necessary.

H. J. Bowman (Berlin):—My first impression, formed some years ago, was that the Association of Ontario Land Surveyors had the ground work for a combined society of Surveyors and Civil Engineers, and that with a few slight additions to our present legislation we could make room for those that were purely engineers, and had no knowledge of the laws regulating the surveying of lands. And I still think that such would have been a much easier method to pursue than the one that has been followed; for we find that the Canadian Society of Civil Engineers met with considerable difficulty and in fact were not able to carry through the Bill they introduced. However, they are seeking fresh legislation, and, judging from what Mr. Chipman says, they will bring up their Bill again shortly, and we must meet the conditions as they are. My recollection of the Bill as finally amended is that it was in such a shape that it would be acceptable to the Land Surveyors; that there was nothing interfering with the interests of those who have applied themselves more particularly to land surveying and who do not take up civil engineering to any great extent. There seemed to have been two opposing tendencies; those Engineers who thought they were above the Land Surveyors, and those Land Surveyors who were content with their present position and did not wish to endanger the status of our present Association; but it seems to me a course can be pursued where the interests of all may be conserved.

I had hoped that Mr. Chipman would have outlined a little more fully the Bill they are going to bring in shortly. He could not have got a more propitious time to present it to this Association, seeing that it has been proposed to-night by our President, our Secretary and different members here to form a Committee, before the Engineers asked us to work in co-operation with them. This is a move in the right direction.

The engineering profession in Ontario is not in as desirable a position as it should be; we find that public money is being spent in some of the large towns, and in the smaller towns and villages of course, very inadvisedly; large amounts are being spent for what should be permanent improvements but these are executed without any engineering supervision what-

ever. Some practical man who thinks he knows all about it has charge of the work and in a couple of years afterwards the municipality find how little that man really did know, and how ill-fitted he was for his position. It is a very easy matter to design a public work to please the people for the day; but to form any opinion as to what the condition of the work may be fifty years hence is a different matter. My observation has led me to believe that a great deal of the money of the municipalities is being thrown away, and the work will have to be all done over again in a few years, just because of want of proper legislation to protect the public from this waste of their money by bringing up a class of Engineers who are not only competent to do the work, but who will get the work, and who will not be underbid by those who have a political pull, or a pull in the local municipal affairs. (Applause).

Mr. Sankey:—Certain members of the Engineering Profession in Ontario objected very strongly to the Engineers' Bill going through. But in the Province of Ontario at large, outside of professional boundaries there seems to be a growing feeling against what are called "close corporations;" and I suppose the Ontario Land Surveyors are sometimes called a close corporation. But any corporation that tries to give the public a good professional man is not a close corporation. Nevertheless the difficulty that the Engineers, or those of any other profession, are going to meet with before the Local House here is the cry of "close corporation;" and until the bodies asking for incorporation show a united front with the Government they are opening the door through which the Government will get out. Want of unity was really what killed the Engineers' Bill. The Legislature of Ontario to-day does not want to run the risk of being told that they are creating a lot of close corporations all over this Province. They will say, "You are not representing this before us in the interests of the whole of your profession." If the Engineers could come together and present a bill before the House that can be supported by every branch of the Engineering Profession I am perfectly sure the Ontario Land Surveyors, who, as a body have possibly some little weight in the Local House, will put their shoulders to and help them to get their Bill through the House.

Mr. Bowman also spoke about the spending of public moneys. It is perfectly true there must be an enormous amount of public money spent in Ontario to-day that is wasted, thrown

away; and unfortunately the Engineering Profession as a body gets the blame, simply because the public does not discriminate between what Mr. Bowman called the ordinary practical man, and the engineer; and the public says, "Oh, an Engineer did that;" and so the Engineering body as a whole gets a bad name.

Mr. Aylesworth:—Mr. President: There are one or two words in Mr. Davis' paper I would like to have eliminated. The writer speaks of money being "squandered on canals and railways." I would suggest that the paper be changed to read "A large amount of money expended." With that change I would move that this paper be received and the thanks of the Association be given to Mr. Davis for it.

Captain Gamble:—I have much pleasure in seconding that motion.

The President put the motion, and, on a vote having been taken, declared it carried.

This Association is not responsible as a body for the opinions expressed in its Papers by Authors.]

SURVEYS FOR MUNICIPALITIES.

BY H. J. BOWMAN, OF BERLIN.

[The following is a summary of the Paper as read by Mr. Bowman, the MSS. having gone astray.]

Those sections relating to municipal surveys form an important part of "The Surveys Act." Particular attention is directed to sections 10 to 13 of the act, relating to boundary lines of townships, and to section 14. In 1897 an important addition was made to this section as follows: (4) On the return of such survey to the Commissioner of Crown Lands he shall cause a notice thereof to be advertised once in each week for four weeks in some newspaper published in the county town of the county in which the lands lie, and shall specify in the advertisement a day not less than ten days from the last publication on which the report of the survey will be considered, and parties affected thereby heard, and on the hearing the commissioner may either confirm the survey or direct such amendments or correction to be made as shall seem just, and shall confirm the survey so amended or corrected, and the lines or parts of the lines so surveyed and marked as aforesaid, shall thereafter be the permanent boundary lines of such concessions or side roads or part of concessions or side roads to all intents and purposes of law whatsoever, and the order of the said commissioner confirming the said survey shall be final, and conclusive upon all parties; and shall not be questioned in any court whatsoever; 60 Vic., Chap. 27, Sec. 14.

Previous to this amendment to the act these municipal surveys had much the same standing as surveys for private individuals, but now, no doubt there will be applications for many more.

Section 15 deals for the first time with angles of lots, and all surveys under this section are to be confirmed in the manner provided in the previous section. The foregoing refers to those portions of "The Surveys Act," known as "Municipal" surveys. It is evident that these sections of the

act apply only where the original survey was made by the Crown, and there is no question but that they will be in the interest of the people at large. Many towns and villages in this province were laid out for private individuals many years ago, and now the street lines are in many cases obliterated. Some means should be provided so that the councils of all municipalities may have resurveys made; also in many towns permanent cement walks and other street improvements are being made without having the street lines properly defined. . The writer would suggest that in all cases the application of the municipal council be to the County Judge who would appoint an Ontario land surveyor to do the work. On the return of the survey the County Judge should cause a notice to be advertised in some newspaper, and specify the day when the report of the survey will be considered, and the parties affected thereby heard, after which the survey, being amended if necessary, would be confirmed. In 1897 an important amendment was made to this section, so that now surveyors must follow the method adopted in making the original survey as shown on the plan of same. This would be filed in the Registry Office, and could easily be produced at the County Judge's chambers should it be necessary when a survey is being confirmed.

DISCUSSION.

Mr. H. J. Bowman:—This opens up a field for discussion; and as I see the next order on the programme is a discussion, I hope the members will state briefly what they think about this proposition for putting our surveys on a little better footing.

Mr. Dickson:—I think the idea of having monuments planted at the corners of streets and so on is a capital one. You have all no doubt had practice in village and town surveys. I know in my town the first thing I have to do is to establish the intersection of streets, and in many places there has only been a bit of a post, perhaps two inches square, put down and no lot number on it; such posts last only for two or three years, and then they are gone. I think it should be compulsory for the municipalities and the owners of land to plant permanent monuments in new surveys, and also for municipalities, towns and villages, to put an iron post of about an inch and a half or two inches in diameter say, three feet long, at the intersection of streets already laid

out, leaving six inches or a foot above the ground, with the name of the street stamped on the side next to the street, and the number of the lot on the other side. They do so in Manitoba.

Mr. Sewell:—I think while discussing this subject it would be well if our Committee on Legislation would look into the wording of those municipal sections under which we work. I am speaking from personal experience. I know that the sections only call for a very limited amount, now, for instance, if you wanted to lay out a block of two or three Concessions, where the posts were pretty nearly lost, you cannot do it under the Municipal Act, it is not provided for. You can run along one concession, but you cannot turn round the corner and go down, that is prohibited; if you do, the Surveyor is going to be left in the lurch, as I was on one occasion, to the tune of about $200.

President Ross:—Did you carry out your instructions ?

Mr. Sewell:—I carried out my instructions from the Crown Lands Department. It was in the Township of Papoonge, where I surveyed a large block; I got $500 from the Crown Lands Department, and the rest I was to get from the Municipality. I found out afterwards that the whole transaction was illegal.

President Ross:—The parties who gave you the order were responsible.

Mr. Sewell:—But it couldn't be assessed. There was no law for assessing it—it couldn't legally have been assessed. There is a clause in that Act that provides for the assessment for the payment.

Mr. Aylesworth:—In the early part of the paper the writer says there is no machinery for confirming municipal surveys.

Mr. H. J. Bowman:—Made for a County Council.

Mr. Aylesworth:—The instruction comes from the Commissioner of Crown Lands; and the report is made to his Department, and the survey is approved by him, and payment made to the Surveyor; isn't that a confirmation of it ?

Mr. H. J. Bowman:—There is no method given in the Act for confirming surveys made for County Councils; but there is a method laid down for confirming those made for Township Councils.

Mr. Aylesworth:—Bench marks may be put down, but before that is done instructions have to come from the court, and the report should be made to the Crown Lands Department. When

that report is made, and approved, and payment made, is not the survey confirmed as to the courses and distances and so-forth ?

Mr. H. J. Bowman:—I wish we had some of our standbys—Mr. Gibson or Mr. Kirkpatrick—here in discussing the Act, but I think every member knows until this amendment of 1897 there was nothing in the Act that prevented municipal surveys of any kind from being reviewed by the courts, and, if there was any later evidence, the whole thing could be set aside. In 1897 a subsection was added:—

Mr. Aylesworth:—But it did not cover the former sections.

Mr. H. J. Bowman:—A subsection was added to section 14 which deals with surveys for Township Councils; and I think it is very plain now that the courts hold no jurisdiction to take up and set aside a survey of that kind. The subsection says it shall not be questioned in any court whatever. Now, the intention of the Legislature is that those surveys made by the instructions of the Commissioner of the Crown shall be final, even should there be some evidence later on to show that there might be a difference of opinion. But that method of confirmation is not attached to the previous clauses where surveys of boundaries have been made. It does not apply to them. If it is a good thing why should it not be made to apply to those. I do not suppose there are many surveys of that kind made, but there might be.—

Mr. Aylesworth:—Some years ago I remember a case of a survey in the Township of Hinchinbrook and the Surveyor making his verification failed to get some original posts, afterwards I found those posts, got evidence, went into court and upset his survey altogether as far as those lots were concerned.

Mr. H. J. Bowman:—By advertising in the newspapers opportunity would be given to the parties interested or who owned the lots to come forward with their evidence; and if they did not appear either personally or by counsel before the Commissioner of Crown Lands the survey would then be final and would be confirmed, and later evidence would not be received and so they would be the losers. It has to be advertised in the County Town. Some county towns have not a newspaper—at least one county town. This might occasion a difficulty such as that experienced by my friend Mr. Sewell; and when the Act is being revised again, as it is periodically, it might be amended to read, the County Town or some other town in the County.

Mr. Aylesworth:—The paper is a valuable one and I move

it be received and adopted and printed; I would like to have it referred to the Committee on Legislation so that they might take up the suggestions and if possible have them carried out.

Mr. H. H. Gibson:—Is it the intention of this paper to make it compulsory to have surveys made or make a similar survey as provided for township surveys?

Mr. H. J. Bowman:—Now, the Act only applies to surveys made for the Crown or those that have the same effect—original surveys. We know, for instance on the line of the Grand Trunk West, that towns were laid out at the time the railway was building and large subdivisions of three or four hundred acres were made, and at present there is no way by which a re-survey can be made at the expense of a Municipal Council, and monuments planted, and an advertisement put in the newspaper, and people given an opportunity to come forward and bring in evidence; there is no means of doing so in these towns. The Act simply applies to those towns where the original survey was made for the Crown, or for the Canada Company, or for some other company or individual that had the grant direct from the Crown of a large tract. There is no way of having an ordinary subdivision resurveyed and put in such shape that the matter will not be questioned by the courts.

Mr. Sewell:—The only way to do it is to file the affidavits.

Mr. H. J. Bowman:—That does not do any good; the matter can be brought up in court again. To make a particular case, in my town (Berlin) there was a large survey made of some three or four or five hundred acres along the Grand Trunk; this survey was made at the time the Grand Trunk was built, and there were no stone monuments planted in that survey; it was made fifty years ago, and now, the old fences are gradually disappearing. There are no cows running at large in the town, so that people do not feel like putting up fences in every case, because fences cost quite a bit of money, and they are rather unsightly sometimes, so that as the fences decay they simply have them removed and have the fence line marked perhaps by some little cedar hedge or something of that kind—or perhaps not at all. You will find very few places on that survey where the street lines can be got at by any monuments whatever. There was a case in court recently, held before the County Judge, and he dismissed the action because there was no evidence to show where the street line was. The action was a matter of trespass; and the Judge said, "You could not prove where the line was." As time goes on

this will become worse. If a survey were now made at the expense of the municipality to put stone monuments at the intersections of the streets, some evidence can still be had. The old residences and the old fences, if left standing, are mute evidence of the approximate location of the street lines, and a resurvey could be made and advertised; and that would be much better than if the matter were deferred to later on. I think the Act ought to be extended to apply to all the municipalities; it is a good thing to apply it to all.

Mr. H. H. Gibson:—I quite agree with Mr. Bowman on this subject, that this law should be extended to villages and towns, and even cities, for we meet with a great many difficulties in locating the angles of streets and lots, and in many cases it would be impossible to locate the original ones. I have a good deal of this work to do myself. At the present time I am making plans for two villages; I have been making them for three years. I am always guided by the Registrar's wish to hurry the matter or let it stand; and in the present case he did not want me to hurry it. In one of these villages boundaries are very easily located—in the other one, which was a very old village, it was almost impossible to find the boundaries at all along certain streets; it was built on a marsh, with a main road up through the village, where they had laid the logs over the swamp, leading to the mills; and I had to establish that road as well as I could, to put it on my plan.

The Registrar in the north part of the County of York has adopted rather a peculiar method in reference to registering plans of villages; he wishes me to show upon this plan any lots that are not shown on the registered plan, and give those lots special numbers, commencing at No. 1, and going up as high as they run—there would be perhaps 150 lots on the total plan; and he registers these lots the same as an ordinary registered plan; and any deeds registered after that, have to refer to that plan, as No. so and so, and the plan has the same authority as a registered plan by an individual, in his opinion. I would like to hear some opinions on this matter, if it does not interfere with the discussion on Mr. Bowman's paper.

President Ross:—In Welland County the Registrar requires all lots not laid down on a registered plan to be designated by some letter or number; and they have all to be designated by that letter or number in every transfer afterwards; and he claims that he does that with the approval of the Inspector of Registry Offices. Of course unless lots are so designated, the value of a compiled plan is not nearly so great as it should be.

With regard to the setting of stone monuments, there is no authority now. When a Surveyor undertakes to make a corporation plan, if he indicates the angles of the corporation, he thinks he is doing a very good thing, but in a great many towns and villages they do not know even where the angles of their corporation are. After a time they forget even when they were incorporated, or by what authority they became incorporated, and forget where their actual boundaries are. Heavy substantial stone monuments could not be easily removed or thrown away, and they should be set at the intersection of important streets or roads in all municipalities.

Mr. H. H. Gibson:—Where would you place these monuments ?

President Ross:—In a convenient place, indicating their position by offsets which could be shown on the plan. Every difficulty as to position could be easily overcome.

Mr. H. H. Gibson:—It is impossible to put them at the corner of the lot in many cases, for instance where there are large buildings.

President Ross:—A Surveyor going out to make a survey in many places may spend much time, and though he may make a correct survey, if he goes into court, it would be hard to prove that his work is correct, because so many things have of necessity to be supposed, and most surveys that are made become matters of evidence. While you might call it a legal survey in one way, it would be impossible to say that it is actually correct according to the original surveys, or monuments planted in the original surveys. If advantage were taken of this Act, there is no doubt it would be a very good thing for the people, and probably for the Surveyors too.

Mr. Davis:—I had some experience a few years ago on the first question Mr. Gibson raised; I was called upon to make a resurvey of five villages in one township; and the plans I made were filed in the Registry Office, and I believe they have superseded the old plans largely. The lots were all renumbered; letters were used for the blocks, and figures for the numbers of the lots. I think there was a great weakness however in the survey, from the fact that no monuments were planted, and the lot corners are not established any more to-day than they were before that survey, and trouble may arise in the future, just as in the past, in reference to the subdivisions. In fact, I have since been called upon to locate a special lot in one of those villages, and in order

to locate it definitely, one of the old residents was brought forth who knew of a place between the lots, on the borders of the road, where Mr. A. B. Pary, many years ago, planted a post; and we spent a forenoon in digging all along that street, and finally found this cedar post which no doubt established that corner; and our survey was made accordingly. I fully concur with Mr. Bowman in his ideas regarding this subject. Where these surveys are made, whether Township boundaries or Concession boundaries, or town lot boundaries, a stone monument or an iron monument of some kind should be planted. With regard to the buildings standing in the way of a corner in a town or city, the plan adopted in Winnipeg, that I noticed on the general plan there of the city, and which perhaps is adopted here and elsewhere, of laying down a line at a certain number of feet, say six or ten feet, from the corner of the block upon which all those iron monuments have been planted, and stamped as suggested by Mr. Dickson, would be useful. While it is not the actual corner, it designates the corner as being a certain number of feet in from this established line, so that it becomes an easy matter at any time in that city to locate any corner of a block.

Mr. Dickson:—Is that the case in all streets, or only where buildings are in the way ?

Mr. Davis:—I believe that prevails all through the City of Winnipeg; a red line is laid down on the plan parallel with the road and six or ten feet from the corner.

President Ross:—The City Surveyor's plan.

Mr. Davis:—Yes.

The President:—It would have no legal standing; it would be only a private reference.

Mr. Davis:—I do not suppose it would have any legal standing; but there is no reason why it could not have authority in all the plans that are registered.

Mr. Arthur Harvey:—Mr. President, I beg to present you with a couple of pamphlets bearing on the metric system, which is a subject I have been led to take some interest in lately, and I thought it would be a matter for discussion at this Convention.

President Ross:—Thank you. We had a slight discussion on that subject a few minutes ago; we are very pleased to get the information. Have you anything further to offer the meeting ?

Mr. Harvey:—I have nothing to offer. I will be glad if the

Society will express its opinion as to the matters to which I have alluded in the communications I have given you.

Mr. Warren:—I think Mr. Bowman's paper is very interesting, and a very important paper. Those of us especially who have been long in practice would know these corners and places, where perhaps some of our younger Surveyors would not. I know in villages in the County of Halton it has been in some cases very difficult to locate these points; but if stone monuments or permanent monuments had been placed years ago, they could have been much more readily established and found; I know in the Village of Georgetown a stone had been planted by Mr. Joseph Black, an old Surveyor, as marking an important corner of a street, but the owner built a stone house at the corner, and instead of leaving that stone monument, or putting a permanent one, he carefully carried away the stone, and he has it upstairs in his house so that it can be looked at there. I was looking for that stone in making a survey; and he told me that he had it upstairs in his house. It might as well have been in Botany Bay. I think we should ask that the suggestions in this paper be enforced now, while many of these places could be established that possibly we may not be able to establish later on. I know cases in Georgetown, and in other villages in the County of Halton, of posts being found by digging down in the neighborhood where either a fence post or the corner post of the lot had been. Another difficulty arises from the fact that the Surveyors' chains were not tested to the millionth part of an inch, as they are in the Standard now, for sometimes the chain was a link long; I know in that county, taking all the lots, the chain must have been fully a link long, because every lot measures about thirty chains and thirty links. It is very difficult now to make up a division of lots by actual measurement. The Surveyor might have surveyed one part of the village, and his chain was so and so, and the longer he went, the longer his chain went. It should not only be in towns, but in villages, cities and townships that the corners ought to be established permanently. In many of the newer townships those corners can be established, but in the older ones it would be almost impossible to do it, except by the old fence posts, and they cannot always be found. I approve very much of the paper, and I hope it may be acted on.

Mr. Sewell:—Sometimes in measuring over the same piece of ground with the same tape, I have found the distance between these posts considerably shortened when the ground was cleaned.

President Ross:—It makes a difference who measures it, and what state the ground is in

Mr. Sewell:—Where I measured myself over the same ground, I found a difference after the ground had been cleaned up, from what it was in the bush.

Mr. Bowman:—One remark, before closing. There seems to be an opinion on the part of some of the members that there should be legislation compelling the municipalities to have particular lines defined. I think we ought to go rather slow in that direction, and that the first thing is to get machinery by which they may have their street intersections defined. I think it would be a very good idea to have this matter referred to the Legislation Committee, and then we might get legislation that would make it possible to have it completed. The matter might be brought to the attention of Municipal Councils. A circular might be issued by the Association.

President Ross:—This Committee might take steps—

Mr. Bowman:—Yes; pointing out to the Municipal Councils the desirability and economy of having it done now, of having their street intersections marked by planting monuments, and having a small appropriation made in their estimates for doing so, because a dollar spent now will save ten dollars or more to their rate payers later on. I think if we brought the matter to their attention that a good many municipalities would have it done. We should not try to force them to have it done; we need not do that.

President Ross:—We cannot do it.

Mr. Dickson:—I think it would be well to have it compulsory on any person sub-dividing lands in the future to have the corners and intersections of streets so identified. An iron post an inch and a half or two inches in diameter will cost very little.

President Ross:—An iron post could be taken up and thrown away.

Mr. Dickson:—Yes, or a stone could be thrown away; but it would cost much more and be harder to plant.

Mr. H. H. Gibson:—Around Toronto they use our wooden stakes for kindling-wood; as fast as you plant them they are taken up and used.

President Ross:—I suppose you do not usually plant anything, but make a plan.

Mr. H. H. Gibson:—We make the plan.

PAPERS USED AT THE FEBRUARY SESSION OF THE BOARD OF EXAMINERS, 1901.

PRELIMINARY EXAMINATION.

SUBJECTS NOS. 1 AND 2.

PENMANSHIP AND GRAMMAR.

1. What is grammar? What is a sentence? Into what parts are sentences divided, and how are they classified? Give examples of each, and divide them.

2. Define inflection, and give examples explaining them.

3. What are pronouns? How many classes are there? Give examples and explain.

4. What part of a sentence depends on the verb? How many moods are there? Classify the tenses. Give examples.

5. Fill in the blanks in the following:

I did that lest he ——— suspect my object.

He promised that it ——— not occur again.

Distinguish the following: You will (shall) have another chance.

If that was (were) the case, what ought I to do?

6. Explain generally the rules of punctuation, and when should capital letters be used?

PENMANSHIP.

Write neatly and carefully letters on the following subjects, giving proper headings and endings:

To the Commissioner of Crown Lands for Ontario, asking for information as to how an application for a mining grant is to be made.

To a sister, giving an account of your visit to a town.

ARITHMETIC.

Subject No. 3.

1. Express the following as mixed or whole numbers,

$$\frac{231750}{153} \qquad \frac{14264}{239} \qquad \frac{25713}{1168}$$

Reduce the following to improper fractions.

$$26\tfrac{201}{202}, \quad 164\tfrac{118}{441}, \quad 157\tfrac{132}{187}$$

2. Reduce to decimals:

$$\tfrac{1}{2}+\tfrac{1}{8}-\tfrac{1}{25}; \quad \frac{47\frac{5}{8}}{94} \text{ of } \frac{11\frac{3}{4}}{7.5}$$

Reduce to circulating decimals:

$$\tfrac{3231}{3326}, \quad 7\tfrac{962}{3387}, \quad \tfrac{17}{99000}$$

Find the vulgar fractions equivalent to the following,

$$.00185, \quad 3.\dot{0}2\dot{4}, \quad .01236$$

Give the rule for the latter and explain it.

3. If a man walk 62 miles in 3 days, in how many will he walk 80 miles?

How many men must be employed to finish a piece of work in 15 days, which 5 men can do in 24 days?

A church clock is set at 12 on Saturday night, at noon on Tuesday it is 3 minutes fast. What will be the time when the clock strikes 4 on Thursday afternoon?

4. Define square and cube root. Extract the square roots of

$$98596, \quad 37249, \quad 11664$$

$$\tfrac{3}{5}, \quad \tfrac{1}{17}, \quad 2\tfrac{1}{2}, \quad \frac{3\frac{1}{2}}{4\frac{1}{2}} \text{ to 4 Places.}$$

Find the cube roots of 54872, 110592., 300763.

5. Three townships have to raise among them $7,450, each in proportion to its assessment, which is $1,745,680; $2,385,000, and $4,763,540; find to the nearest cent the proportions?

6. If a cubic foot of water equal 25 quarts, how many gallons will pass under a bridge every 10 minutes; the stream is 23 feet

8 inches wide, average depth 3 feet 6 inches, rate 3½ miles per hour.

7. Find the values of 1,270 boards 15′ x 13″ x 1¼″ at $18.50 per M. 1,750 scantlings 16′ x 7″ x 3½″, at $23.75 per M. A pile of cordwood 5½′ x 26½′, at $3.75 per cord.

8. A merchant sold 4000 yds., of cotton at 7½ cents per yard. What should he remit his principal, his commission being 1¾ per cent. and expenses amounting to $45.60.?

(*A*) LOGARITHMS, AND (*B*) ALGEBRA.

Subject No. 4.

(*A*).

1. *(a)* What is the Logarithm of a number ?

(b) How many kinds are there in use, and what is the base of each ?

(c) Explain each part of a Logarithm, and give the name of each part.

(d) What operations of calculation can be performed by the use of Logarithms ?

2. Find the Logarithms of the following numbers: *(a)* 1; *(b)* 10; *(c)* 100; *(d)* .0002507; *(e)* 23764; and *(f)* 237.64.

3. Find the numbers corresponding to the following Logarithms, *(a)* .812913; *(b)* 2.524656; and *(c)* $\bar{1}$.276692.

4. Calculate the value of $\sqrt[4]{\frac{1}{249}} + \sqrt[5]{\frac{23}{11}}$

5. Multiply together the following by using Logarithms: 1728; .00024; .7462; 302.1 and 7.6094.

(*B*).

6. *(a)* Explain the difference between an exponent and a coefficient, and how are each treated in Multiplication and Division ?

(b) What is the law of signs in Multiplication ?

7. Remove the symbols of aggregation from the following:

(a) $2a - \{3b + [4c - 4a - (2a + 2b)] + [3a - \overline{b + c}]\}$

(b) $7a - \{3a - [(2a - 5a) + 6a]\}$

(c) $a - \{2b + [3c - 3a - (a + b)] + [2a - (b + c)]\}$

8. Divide by Horner's method:

$$6x^5 - x^6 - 11x^3 + 16x^4 + x^3 + 8x^2 - 19x + 20 \text{ by } 2x^3 + x^2 - 3x + 4$$

9. Factor (a) $x^8y^2 - 64x^2y^2$.

(b) $a^2 - b^2 + c^2 - 1 - 2a + 2bc$.

(c) $1 - 16a^2 + 8ac - c^2$.

10. A man has two horses and a saddle. The saddle is worth $10, and if it be put on the first horse his value with the saddle becomes double that of the second; but if the saddle be put on the second horse his value with it will not amount to that of the first horse by $13. Find the value of each horse.

EUCLID.

Subject No. 5.

1. (a) The greater side of a triangle has the greater angle opposite to it. I. 18.

(b) Prove I. 18 by producing a side.

2. ABC is a triangle with AC greater than AB. From AC cut off AD equal to AB. Produce AB to E, making AE equal AC. Join BD and EC. Prove that the angle DBC is equal to the angle BCE.

3. (a) If a straight line be divided externally into any two segments, the square on the straight line is equal to the squares on the two segments diminished by twice the rectangle contained by the segments.

(b) AB is a straight line, with its centre C. D is a point of unequal internal section, E is a point of external section: enunciate or give by numbers the propositions based upon these sections.

(c) Deduce algebraically II. 7 from II. 4.

4. Solve any one of the following deductions:

(a) In any triangle if a perpendicular be dropped from the vertex on the base, the difference of the squares on the sides is equal to the difference of the squares on the segments of the base.

(b) Find the point in the base of a triangle from which lines drawn parallel to the sides to meet them are equal.

(c) If A be the vertex of an isosceles triangle ABC, and CD be a perpendicular to AB. Prove that the sum of the squares on the sides of the triangle is equal to the sum of the square on BD, twice the square on AD, and three times the square on CD.

5. *(a)* In every triangle, the square on the side opposite an acute angle is equal to the sum of the squares on the other two sides diminished by twice the rectangle contained by either of those sides and the projection on it of the other side.

(b) State the relation of the square on the side of a triangle to the sum of the squares on the other two sides as the angle contained by these sides is acute, right or obtuse.

6 What is the purpose of Book II ? of Book III ?

7. From any point in the base of a right angled triangle a line is drawn at right-angles to the hypotenuse; prove that these lines are divided into segments whose rectangles differ by the square on the line so drawn.

8. *(a)* If two circles touch one another, internally at any point, the straight line which joins their centres, being produced, shall pass through that point (III 11).

(b) Two circles touch internally at a point, and through that point a straight line is drawn to cut the circumferences of the two circles. If the points of intersection be joined with the respective centres, the two straight lines will be parallel.

9. *(a)* Angles in the same segment of a circle are equal. Conversely: If two equal angles stand on the same arc, and the vertex of one of them be on the conjugate arc, the vertex of the other will also be on it (III. 21).

(b) If triangles having equal vertical angles stand on the same base, find the locus of their vertices. Show whether the angles at the base change their relations to each other.

10. *(a)* About a given circle describe a triangle, equiangular to a given triangle. (IV. 3).

(b) Compare as to length the sides of an equilateral triangle inscribed in a circle with one described about it.

PLANE TRIGONOMETRY AND RULES FOR SPHERICAL.

Subject No. 6.

1. Draw a figure showing by lines the trigonometrical functions of an arc, and give the definitions.

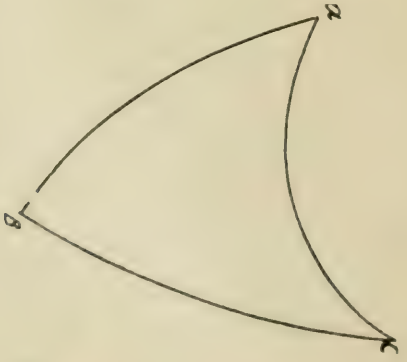
2. Show that the unit of circular measure is equal to $57^{\circ}.2958$ nearly. Reduce the angle 60 degrees to circular measure.

3. Give rules for solving plane right angled triangles. The four cases of right angled triangles. Give proofs of rules.

4. In surveying a Base Line in the District of Algoma, I find it necessary to calculate the distance AC. I measure the lines AB, BC, and angle B. $AB = 5.62$ chains; $BC = 3.20$ chains. Angle $B = 128^{\circ}\ 4'$. Find length of AC.?

5. Give Napier's rules for solving right angled spherical triangles.

6. In the spherical triangle ABC, right angled at B, the hypothenuse AC is 64 degrees, and the angle C 46 degrees. What are the remaining parts ?



Subject No. 7.

MENSURATION OF SUPERFICIES.

1. Find the area of a field bounded as follows: N. 34° 15′, E. 2 chs. 75 lks., N. 85°, E. 1 ch. 28 lks., S. 56° 45′, E, 2 chs. 20 lks., S, 34° 15′, W, 3 chs. 53 lks, N. 56° 30′, W. 3 chs. 20 lks. Give the area in acres, roods and perches.

2. The area of a rectangular field is 7½ acres, and the length of the diagonal is 50 perches. Required the sides in perches.

3. Find the area of a field one side of it being 198 links and seven ordinates to it measured at equal distances to the opposite curvilinear boundary being in order equal 60, 75, 80, 82, 76, 63 and 50 links.

4. State the rule for finding the area of a quadrilateral when the four sides and inclination of the diagonal are given.

Subject No. 8.

LINEAR DRAWING.

1. Draw a perpendicular to a straight line when the point is nearly over the end of the line.

2. Construct an equilateral triangle, the vertical height being two inches.

3. Draw a rectangle having its sides 1½ inches and ¾ inch respectively, and construct a square of equal area.

4. Draw two circles of one inch and half inch radius respectively, the centres being three inches apart. Draw two tangents to the two circles.

5. Draw a scale of inches six inches long, divide the first division into ten minor divisions, number the divisions properly, and print over it "Scale of inches."

6. Draw six lines, four inches long—No. 1, very fine; No. 2 medium; No. 3 fine dotted; No. 4 chain dotted; No. 5 heavy dotted; No. 6 heavy.

Subject No. 9.

CANADIAN AND GENERAL GEOGRAPHY.

1. Trace either by description or diagram, the main mercantile waterway of the Dominion, giving names of different parts, and principal towns on same.

2. Name the British possessions at present date.

3. State the principal Rivers and Mountain ranges of the world, and give names of the Countries in which they are situated.

4. Over what oceans would it be necessary to pass, to circumnavigate the world. Name the principal groups of Islands in them.

5. Give the names of the Capitals of the principal countries of Europe and Asia.

Subject No. 10.

CANADIAN HISTORY.

1. Give names of the principal explorers of Canada during the French regime, and points of discovery of same.

2. Give names and location of the principal Indian tribes of Canada at the time of the British occupation.

3. Give dates and principal battles of the Wars in Canada with the United States.

4. State concisely the circumstances that led up to the establishment of "Responsible Government" in Canada.

5. At what date did Confederation take place, and what was the form of Government established by the British North America Act?

FINAL EXAMINATION.

Subject No. 1.

GEOMETRY.

1. Book I, Prop. 43. The complements of the parallelogram, which are about the diameter of any parallelogram, are equal to one another.

2. On a given line describe a square of which the line shall be the diagonal.

3. If two sides of a triangle be produced, the lines, which bisect the two exterior angles and the third interior angle, meet all in one point.

4. Book II, Prop. 5. If a straight line be divided into two equal parts, and also into two unequal parts, the rectangle contained by the unequal parts, together with the square of the line between the points of section, is equal to the square of half the line.

5. Book III, Prop. 36. If from any point without a circle two straight lines be drawn, one of which cuts the circle and the other touches it, the rectangle, contained by the whole line which cuts the circle and the part of it without the circle, shall be equal to the square of the line which touches it.

6. Given the area and hypothenuse of a right angled triangle; construct it ?

7. Book IV, Prop. 9. To describe a circle about a given square.

8. Book VI, Prop. 8. In a right angled triangle, if a perpendicular be drawn from the right angle to the base, the triangles on each side of it are similar to the whole triangle and to one another.

9. Book VI, Prop. 30. To cut a given straight line in Extreme and Mean ratio.

10. Define "Homologous," "Ex Equali," "Analogy," "Ratio," "Proportionals."

Subject No. 2.

ALGEBRA.

1. Simplify:

(a) $$\frac{\frac{1}{1-x} - \frac{1}{1+x}}{\frac{1}{1-x} + \frac{1}{1+x}}$$

(b) $$\frac{\frac{a^2}{b^3} + \frac{1}{a}}{\frac{a}{b^2} - \frac{a-b}{ab}}$$

(c) $$\frac{1}{x + \frac{1}{1 + \frac{x+1}{3-x}}}$$

2. Prove that any ratio is made more nearly equal to unity by adding the same number to each of its terms.

3. What is the

(a) Arithmetical ratio of $x^4 - 1$ to $x + 1$.

(b) the Geometrical ratio of the same.

4. A man performed a journey of 48 miles in a certain number of hours but if he had travelled 4 miles more each hour he would have performed the journey in 6 hours less time. What was his rate per hour ?

5. Solve:

$$\sqrt{x^2 - a^2 - b^2} + \sqrt{x^2 - b^2 - c^2} - \sqrt{x^2 - c^2 - a^2} = x$$

6. Define:

(a) Arithmetical Progression; Geometrical Progression; Harmonical Progression.

(b) Insert 5 Harmonic means between 1 and 7.

7. Find two numbers whose sum is nine times their difference and whose product diminished by the greater number is equal to twelve times the greater number divided by the less.

8. *(a)* Find the greatest term in the expansion of $(a+b)^{20}$ when $a=2$ and $b=3$.

8. *(b)* Find the value of the greatest term in the following: $(a-b)^{2r}$.

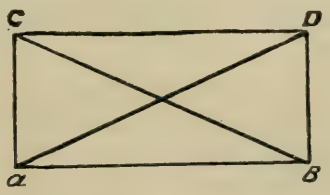
when $a=2$, $b=3$, $r=4$.

Subject No. 3.

TRIGONOMETRY (PLANE AND SPHERICAL).

1. Give the rules and prove the same for solving plane triangles. *(a)*. Given one side and two angles, each adjacent to given side. *(b)*. Given one side and two angles, one adjacent and the other opposite, to given side. *(c)*. Given two sides and included angle.

2.



$AB=1000$ yds. Angles $BAC=76°\ 30'$, $BAD=44°\ 10'$, $ABD=81°\ 12'$, $ABC=46°\ 5'$. Find distance CD.

3. Give Napier's rules for the circular parts for solving spherical triangles, with proofs for same.

4. In the spherical triangle ABC, right angled at B, the hypothenuse $AC=64$ degrees, the angle $C=46$ degrees. What are the remaining parts?

5. What is spherical excess and what useful purpose may it be made to serve.

6. What is a quadrantal spherical triangle and how are they solved ?

7. Show that the unit of circular measure is equal to $57^{\circ}.2958$ nearly.

Reduce the angle 60° to circular measure.

Subject No. 4.

MENSURATION AND LAYING OUT LAND.

1. Give the method of finding the area of any irregular polygon.

2. State rule to find area of a quadrilateral, when the four sides and inclination of the diagonals are given.

3. Find the length of an arc of a circle whose diameter is 125 and number of degrees in the arc $54^{\circ}\ 36''$.

4. Prove rule for dividing a triangular piece of land into two parts having a given ratio to each other, by a line through a given point within the boundaries.

5. Find the area of field, one side of it being 198 links and seven ordinates to it measured at equal distances to the opposite curvilinear boundary being in order, equal 60, 75, 80, 82, 76, 63 and 50 links.

6. Find the number of acres in a quadrilateral field whose diagonals are 30 and 40, and the contained angle 60°.

Subject No. 5.

RE DESCRIPTIONS OF LANDS.

1. *(a)* Give a definition of the word "description," as used in a technical sense by O. L. Surveyors.

(b) When is a description complete in itself ? Write one.

(c) When is a description incomplete ? Write one.

(d) Give example of wrong description by referring to defective points that may occur.

(e) Give a list of the different kinds of descriptions of lands in various forms which may occur in practice.

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2. Lot 35 in Concession A, single front, in Township Block is the last lot in the Concession, the town line being along the north side. The Patent from the Crown describes the lot as 200 acres and sides 100 chains and ends 20 chains each, on Survey Lot found to be north side 105 c, south side 101 c, west end 22 c., east end 25 c. In said Patent courses of sides said to be N 74° E, and ends N 9° W.

(a) A description is required of the east and west halves, each, giving the dimensions in detail.

(b) Also a description of the north-east quarter in detail. tail.

(c) Also a description of a school lot of two acres on the north-west corner, with frontage on west end of two chains.

(d) Also a description in detail of the westerly 100 acres.

(e) Show by sketch the south-east quarter of the south-east quarter of the north-west quarter of said lot.

In all above cases show sketch with description, and calculations may be made approximate.

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3. Lot 10, Concession A, single front, Township Block, is 100 c by 20 c, and sides N 74° E, and ends N 16° W.

(a) Required a description of a road to be laid out across the lot, the centre line of which commences at the south-west angle of the lot, and ends at the north-east angle of the west half of the lot, road to be 1 chain wide; make description in detail, with sketch.

(b) Give a description of the east half of said lot with a right of way over the west half of said lot, 50 links wide along the south side of west half. Show by sketch also a description to be in detail.

(c) Write a description of the north-easterly half of the lot as cut off by a diagonal line from north-west corner to south-east corner; description to be in detail.

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4. *(a)* Mr. White owns lot 20, plan 1,000, part of township lot 35, Concession 1, Township H; the lot is 50′ x 150′, front N 16° W and sides N 74° E. He has a double house built on the lot; the party or middle wall is, or is supposed to be, on the south limit of the N half of the lot. He wants a description to cover the north half of the lot, but to include the north semi-detached house. House 10′ from front, and 60′ deep, and each 20′ wide.

(b) Write also a description of the south half of said lot, considering it not built upon. Description to be in detail.

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5. *(a)* A man owns lot 10, Concession 1, Township A, 20 c x 100 c, 200 acres; saw-mill on west half and pond floods part of east half. Sells west half, and is to give right to flood east half to working head of pond, and right of way 50 links wide along south side east half. Required a description for Deed. Bearings, front of lot N 16° W, and sides N 74° E.

(b) Also write a description for the remaining part of the east half of said lot.

Subject No. 7.

LAYING OUT CURVES.

1. Explain the method of laying out a curve by deflection angles, and prove the ratio of the angle of deflection to the angle at centre.

2. Illustrate method of passing an obstacle, such as a large building, in laying out a curve.

3. What is a compound, and what a reverse curve? Give diagrams of each.

4. Given deflection angle, between tangents 48° 16″ and radius 112 feet, find other angles and distances necessary to lay out the curve.

Subject No. 8.

ASTRONOMY.

1. Define Horizon, Zenith, Nadir, Parallax, Refraction. Explain fully the effects of the latter two in astronomical work.

2. Find the altitude and azimuth of Ursa Majoris (Declination 62° 33′ N.) to an observer at latitude 39° 57′ N. when the hour angle of the star is 5h. 17m. 40s. E.

3. At a place in latitude 25° 40′ N., the sun's correct central altitude was found to be 10° 6′ 27″, when his declination was 8° 5′ 56″ S., what was his distance from the meridian?

4. At a place in latitude 42° 34′N., nearly the altitude of Aldebaran (Declination 16° 12′ 26″ N.), was found by observation to be 39° 2′ 10″, when its hour angle was 3h. 25m. 40s. what was the latitude of the place?

5. The altitude of the pole star being found 39° 1′ 39″, the hour angle 5h. 36m. 41s. from the upper culmination, and the polar distance 1° 28′ 7.68″, required the latitude of the place.

6. On the 1st of January, 1852, the sun's right ascension was 18 hours, 44m., 49.47s., and his declination 23° 3′ 28″ S.,—required his longitude.

7. Give a full description of the precautions necessary to be observed in astronomical observations in order to insure accuracy.

8. Explain fully the cause of day and night and the changes of the seasons, and why it is hot in summer and cold in winter in this latitude, and what effect (if any), would a change in the obliquity of the ecliptic have upon the climate.

Subject No. 9.

RE SURVEY ACT.

1. *(a)* Describe the different kinds of original surveys by Government.

(b) Describe the different kinds of original surveys by private persons and Corporations.

(c) Describe municipal surveys, different kinds and under what precedent do they take the place of original surveys.

(d) What plans, notes and affidavits are received as evidence in Courts ?

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2. *(a)* How are lines between lots run in single front concessions ? Give the different cases which might occur.

(b) How are lines between lots run in double front concessions ? Give the different cases which might occur.

(c) How are lines between lots run in sectional concessions, *i.e.*, where run out in blocks as per Order-in-Council, 27th March, 1829 ? Give different cases which might arise.

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3. *(a)* How would you locate the corner of a lot when the original stake is lost ?

(b) How would you locate a concession line when part is lost ?

(c) How would you locate a concession line which was never run ?

(d) How would you locate a concession line when the whole is lost ?

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4. *(a)* How would you re-survey Government town plots where original stakes are lost ?

(b) How would you re-survey town plots by Corporations where original stakes are lost ?

(c) How would you re-survey town plots by private persons where original stakes are lost ?

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5. *(a)* Under what circumstances can an O. L. S., take affidavits ?

(b) How can an O. L. S. compel attendance of witnesses?

(c) To what extent is an O. L. S., allowed to pass over private property ?

(d) Are O.L.S. bound to keep Field Notes, and if so, how?

SUBJECT NO. 10.

RE DITCHES AND WATER COURSES ACT.

1. *(a)* State the law and precedent as to appointing Engineer.

(b) State the law and precedent as to friendly meeting.

(c) State the law and precedent as to notifying the Engineer.

(d) State the law and precedent as to examination and award by Engineer.

(e) State the law and precedent as to completing work by Engineer when individuals fail.

(B) RE MUNICIPAL DRAINAGE.

2. *(a)* State law and precedent as to commencing work on Petition.

(b) State law and precedent as to appointing Engineer and oath of office.

(c) State law and precedent as to survey and assessment and report.

(d) State law and precedent as to adjoining municipalities.

(e) Define and give illustrations of the meaning of the terms "benefit liability," "injuring liability," and "outlet liability."

(c) RE REGISTRY ACT.

3. *(a)* State how plans should be prepared for registration.

(b) State how plans can be registered where surveys or sub-divisions have been made before 4th March, 1868.

(c) State how plans of cities, towns and villages, which were sub-divided at different times should be made and registered.

(d) RE MINING ACT.

4. *(a)* State how mining claims and locations should be surveyed, and plans and descriptions made in unsurveyed territory.

(b) State how mining claims and locations should be surveyed, and plans and descriptions made in surveyed territory.

Subject No. 11.

LEVELLING.

1. Describe the adjustments necessary for a Wye. Wherein do they differ in a Dumpy ?

2. Give a form for a field book and show typical set of observations reduced to a common Datum.

3. Give form for cross section book.

4. What is a level line ?

5. How would you take into account the sphericity of the earth and allow for it in actual work ?

SUBJECT No. 12.

EVIDENCE.

1. Define the term evidence.

2. What is the best evidence ?

3. Secondary evidence. When is it admissible ?

4. What is hearsay ? and when, if ever, is it allowable ?

5. What position do you consider you occupy when acting as a Surveyor ? What attitude do you consider you should take with regard to evidence ?

6. Draw up an affidavit in full to establish a post.

SUBJECT No. 14.

MINERALOGY AND GEOLOGY.

1. Define conformable and contorted strata. Interstratified and disrupting masses, and fissures and fractures of rock formations.

2. State situation and the constituent rocks of the Huronian and Silurian formations in Ontario.

3. In what geological formations, and in what localities do iron, corundum, nickel and gold, principally occur in Canada?

4. What are the constituents of trap and green stones, and in what manner do they usually occur ?

5. What is Graphite, and what is usually called "Phosphates?"

In what localities in Canada do they principally occur?

6. Name some distinctive fossils of the carboniferous and Silurian formations; and name principal coal deposits of the Dominion.

Subject No. 15.

BOTANY AND FOREST FLORA.

1. What are the parts of a flower? Illustrate by diagrams, and give full descriptions and the use of each part.

2. What is a fruit in Botany? Explain the structure of an apple, grape, almond, strawberry and pine-apple.

3. Describe the structure of endogenous and exogenous stems. How do they differ in growth?

4. Describe the germination of a plant.

5. Name ten trees of Ontario and give their botanical names What are their economic uses.

LIST OF MEMBERS.

31st July, 1901.

The names of those members granted exemption by By-laws ratified by the Association are marked *.

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

Abrey, George Brockitt, Toronto Junction, ...10th Jan., 1860
D.L.S.

Allan, John Richard, Renfrew.....6th Nov., 1894
Grad. S.P.S.

Aylsworth, Charles Fraser, Jr., Madoc.....8th Jan., 1886
D.L.S.

Aylsworth, John Sidney, Selby, P.O. Box 23...9th Jan., 1871
D.L.S.

Aylsworth, William Robert, Belleville,
P.O. Box 2.....8th Nov., 1861
D.L.S.

Baird, Alexander, Leamington.....7th July, 1877
D.L.S., C.E.

Barrow, Ernest George, Hamilton.....4th Oct., 1877
D.L.S., Mem. Can. Soc. C.E., City Engineer.

Bazett, Edward, Burk's Falls.....8th July, 1881
D.L.S.

Beatty, David, Parry Sound.....12th July, 1869
D.L.S.

Beatty, Herbert John, Eganville.....8th Nov., 1893
Grad. S.P.S.

Beatty, Walter, Delta.....19th July, 1858
D.L.S., M.P.P.

Bell, James Anthony, St. Thomas.....11th Oct., 1875
D.L.S., Co. Engineer, Elgin. City Engineer, St. Thomas.

Bigger, Charles Albert, Ottawa, 68 Daly Ave..6th Jan., 1882

Bolton, Ellsworth Doan, Listowel.....7th Nov., 1899
B.A.Sc. (McGill)

Bolton, Lewis, Listowel.....9th July, 1864
D.L.S.

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

Boswell, Elias John, Peterborough.....7th Nov., 1896
Grad. S.P.S.

Bowman, Clemens Dersteine, West Montrose. 10th July, 1879

Bowman, Herbert Joseph, Berlin.....7th Jan., 1887
D.L.S., Grad. S.P.S., Treasurer County Waterloo. Assoc. Mem. Can. Soc. C.E.

Bray, Edgar, Oakville.....6th Oct., 1866
D.L.S.

Bray, Harry Freeman, Oakville.....10th July, 1882

Bray, Samuel, Ottawa, Dept. of Indian Affairs..6th Jan., 1877
C.E., D.L.S.

Brown, George Laing, Morrisburg.....19th Feb., 1898
Grad. S.P.S.

*Brown, John Smith, Kemptville.....8th July, 1852
D.L.S.

Browne, Harry John, Toronto, 18 Toronto st..6th July, 1872
C.E.

Browne, William Albert, Toronto,
18 Toronto st.....10th April, 1876

Burt, Frederick Percy, New York, N.Y.....8th July, 1885
Manager and Treasurer Engineering News Pub. Co., 220 Broadway.

Butler, Matthew Joseph, 22 Wellington Place, Toronto.
.....11th Jan., 1878
M.I.C.E., Mem. Am. Soc. C.E., Mem. Can. Soc. C.E., C.E.

Byrne, Thomas, Sault Ste. Marie.....15th July, 1862
D.L.S.

Caddy, Cyprian Francis, Campbellford.....10th July, 1860
D.L.S.

Caddy, John St. Vincent, Ottawa, 559 King st..6th Oct., 1866
D.L.S.

Cameron, Alfred John, Peterborough.....9th April, 1889

Campbell, Archibald William, Toronto,
Parliament Building .....10th April, 1885
C.E. Provincial Instructor in Road Making.

Carpenter, Henry, Stanley, B.A., Sc.
(Toronto Univ.), Collingwood.....25th Feb., 1899

Carre, Henry, 193 Sparks St., Ottawa.....8th Nov., 1861
M.O. & Georgian Bay Canal, B.A. and C.E. (Trin. Coll., Dublin), D.L.S.

*Carroll, Cyrus, Prince Albert, Sask..... 10 Jan., 1860
Mem. Can. Soc. C.E., D.L.S.

Casgrain, Joseph Philippe Baby, Morrisburg...5th Jan., 1888
D.L.S., P.L.S., (Que.) C.E., Assoc. Mem. Can. Soc., C.E., Chief Eng. M. & P.J. Ry.

Cavana, Allan George, Orillia.....8th July, 1876
D.L.S.

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

Chalmers, John, Port Arthur, per Ont. & R.R. R'y Co.....14th April, 1896
Grad. S.P.S.

Charlesworth, Lionel Clare, Rat Portage.....14th April, 1896
Grad. S.P.S., Agent Bureau of Mines (Ont.).

*Cheesman, Thomas, Mitchell.....11th July, 1856
D.L.S.

Chipman, Willis, Toronto, 103 Bay st.....4th Oct., 1881
B.A.Sc. (McGill), Mem. Am. Soc. C.E.; Mem. Can. Soc. C.E.

Code, Abraham Silas, Alvinston.....14th April, 1896

Cozens, Joseph, Sault Ste. Marie.....7th July, 1875
D.L.S.

*Davidson, Alexander, Arkona.....11th Oct., 1858
D.L.S.

Davis, Allan Ross, Napanee.....8th Jan., 1886
B.A.Sc. (McGill.)

Davis, John, Alton.....5th April, 1878

Davis, William Mahlon, Berlin.....11th April 1885
Grad. R.M.Coll., (Kingston), Town Engineer.

Deacon, Thomas Russ, Rat Portage.....12th Nov., 1892
Grad. S.P.S., Mgr. Mikado Mine.

Deans, William James, Oshawa.....11th July, 1884

DeMorest, Richard Watson, Sudbury.....9th April, 1889
M.E.

Dickson, James, Fenelon Falls.....6th April, 1867
D.L.S.

Dobbie, Thomas William, Tilsonburg.....11th July, 1856
D.L.S.

Dobie, James Samuel, Port Arthur.....21st Feb., 1898
B.A.Sc. (Toronto Univ.).

Doupe, Joseph, Winnipeg, Man., 169 Edmonton st.....13th Jan., 1863
D.L.S., P.L.S. (Man.), C.E. (McGill)., P.L.S. (B.C.).

Ducker, William A., Winnipeg, Man., 334 Pacific ave.....6th April, 1882
D.L.S., P.L.S. (Man.) Swamp Lands Com.

Esten, Henry Lionel, Toronto, 157 Bay st....7th Jan., 1887

Evans, John Dunlop, Trenton.....8th July, 1864
D.L.S., C.E., Chief Eng. Cent. Ont. Ry., Eng. for Weddell Bridge & Engine Works.

Fair, John, Brantford.....13th April, 1875.

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

Fairbairn, Richard Purdom, Toronto,
127 Major st.....7th Oct., 1876
Surveyor for Dept. of Pub. Works, Ontario.

Fairchild, Charles Court, Simcoe.....9th April, 1894
Grad. S.P.S.

Fairchild, William Howard, Simcoe.....17th Feb., 1900

Farncomb, Alfred Ernest, Fort William.....9th April, 1895

Farncomb, Frederick William, London,
213 Dundas st.....6th Nov., 1889

Fawcett, Thomas, Niagara Falls.....6th Jan, 1881
Dom. Topographical Surveyor.

Fitton, Charles Edward, Orillia, Box 142....10th April, 1879
D.L.S.

Flater, Frederick William, Petrolea.....9th April, 1888

Ford, William Butterton, Hamilton,
42 James St., N.....21st Feb., 1898

Francis, John James, Sarnia P.O., Box 304...16th Oct., 1861
D.L.S.

*Fraser, Charles, Wallaceburg.....5th Aug., 1847
D.L.S

Galbraith, William, Bracebridge.....4th April, 1883
D.L.S.

Gamble, Killaly, Toronto, 88 Charles st.....6th April, 1888
D.L.S., P.L.S. (Man.), Captain R.A. (Ret'd).

Gardiner, Edward, St. Catharines.....6th Jan., 1866
D.L.S.

Gaviller, Maurice, Collingwood, Box 164.....6th Jan., 1866
C.E. (McGill), D.L.S.

Gibson, Harold Holmes, Willowdale.....8th Sept., 1891

*Gibson, James Alexander, Oshawa.....7th April, 1855
D.L.S.

Gibson, Peter Silas, Willowdale.....19th July, 1858
C.E. M.S. (Mich. Univ.) D.L.S., Mem. Can. Soc. C.E., Engineer Tp. of York.

Gibson, Wilbert Silas, Willowdale.....21st Feb., 1898

Gillon, Douglas John, Fort Frances.....9th Nov., 1895
Grad. R.I.E. Coll.

Graydon, Aquila Ormsby, London.....8th July, 1880
City Engineer.

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

Hanning, Clement George, Preston, Lock Box 130.....19th July, 1858
D.L.S., C.E, (Trin. Coll., Dublin).

Hart, Milner, Toronto, 103 Bay st.....11th July, 1863
D.L.S.

Harvey, Thomas Alexander, Steelton, Penn...13th Nov., 1893
C.E. (R.P.I., Troy, N.Y.)

Heaman, John Andrew, London, Albion Building.....16th Nov., 1896

Henry, Frederick, London, Albion Building..7th April, 1887

*Hermon, Royal Wilkinson, Rednersville....13th July, 1857
D.L.S.

Hobson, Joseph, Montreal, G. T. Ry. Office.....3rd Oct., 1855
D.L.S., Chief Eng. Grand Trunk Railway System.

Hopkins, Marshall Willard, Hamilton..... ...13th Nov., 1893
D.L.S., B.A.Sc. (McGill), Assoc. Mem. Can. Soc. C.E., Chief Engineer I.R.R.C.

Hutcheon, James, Guelph.....10th Nov., 1891
Grad. S.P.S., City Engineer.

Irwin, James Moore, Rat Portage.....13th Jan., 1863
D.L.S.

Jackson, James Herbert, Windsor.....16th Feb., 1901

James, Darrell Denman, Michipicoten Harbour...3rd Nov., 1891
B.A., B.A.Sc. (Toronto Univ)

James, Silas, Toronto, 114 Shuter St.....19th July, 1858
D.L.S.

Jones, Charles Albert, Petrolea.....8th April, 1881
D.L.S.

Jones, John Henry, Sarnia, Box 194.....10th Oct., 1886
D.L.S.

Jones, Thomas Henry, Brantford.....10th Oct., 1878
B.A.Sc. (McGill). D.L.S. City Engineer.

*Keefer, Thomas Coltrin, Ottawa.....14th Aug., 1840
D.L.S., C.E.

Kennedy, James Henry, St. Thomas.....7th April, 1887
C.E. (Toronto Univ), Mem. Can. Soc. C.E., Engineer of V.V. & E. Ry.

Kirkpatrick, George Brownly, Toronto, Dept. of Crown Lands.....13th April, 1863
D.L.S., Director of Surveys.

Laird, James Stewart, Essex.....6th April, 1867
D.L.S.

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

Laird, Robert, Rat Portage.....11th Nov., 1887
Grad. S.P.S.

Lewis, John Bower, Ottawa, Brunswick House .....4th Oct., 1883
D.L.S., P.L.S. (Quebec), C.E.

Lougheed, Aaron, Port Arthur,.....12th Nov., 1888
D.L.S.

*Low, Nathaniel Edward, Wiarton.....11th July, 1856
D.L.S.

Lumsden, Hugh David, Toronto, 63 Homewood ave.....4th Jan., 1866
C.E., D.L.S., M.I.C.E., Mem. Can. Soc. C.E.

Macdougall, Allan Hay, Port Arthur.....11th April,1859
D.L.S., Town Engineer.

MacKay, James John, Woodstock.....25th Feb., 1899

MacKenzie, William, Sarnia.....11th April, 1896
Grad. R.M.C. (Kingston).

MacKenzie, William Lyon, Cranbrook, B.C.....7th April, 1887
C.E.

MacPherson, Duncan, Montreal, P.Q.....9th Jan., 1884
Grad. R.M.C., M.I.C.E., Mem. Can. Soc. C.E., Div. Eng. Eastern Div. C.P. Ry.

McAree, John, Rat Portage.....6th April, 1867
Dominion Topographical Surveyor, B.A.Sc., (Toronto Univ)

McCubbin, George Albert, St. Thomas, City Engineer's Office.....9th Nov., 1895
Assist. City Engineer.

McDonell, Augustine, Chatham, 4 & 5 Ebert's Block.....11th July, 1863
D.L.S.

McDowall, Robert, Owen Sound.....11th Nov., 1890
Grad. S.P.S., Town Engineer

McEvoy, Henry Robinson, St. Marys.....10th July, 1875
D.L.S.

McFadden, Moses, Neepawa, Man.....13th April, 1858
D.L.S., P.L.S. (Man.)

McFarlen, George Walter, Toronto, City Hall, Assistant City Engineer's Office 11th Nov.,1889
Grad. S.P.S.

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

McGeorge, William Graham, Chatham, Box 225.....8th Jan., 1866
D.L.S.

McGrandle, Hugh, Huntsville.....5th Jan., 1883
D.L.S.

McKay, Owen, Windsor, P.O. Box 167.....7th Jan., 1887
Grad. S.P.S., Chief Eng. D. & L. E. Ry.

McKenna, John Joseph, Dublin.....9th July, 1860
D.L.S.

McLatchie, John, Nelson, B.C., P.O. Box 128....9th Jan., 1864
D.L.S.. P.L.S. (Que., Man. and B.C.).

McLean, James Keachie, Elora.....8th April, 1876
D.L.S.

McLean, William Arthur, Toronto, Parliament Buildings .....21st Feb., 1898
Secretary of Roads.

McLennan, Murdoch John, Williamstown...13th Nov., 1893
B.A.Sc. (McGill), D.L.S.

McLennan, Roderick, Toronto, 115 Avenue Rd.....20th June, 1846
D.L.S.

McNab, John Duncan, Owen Sound.....9th Oct., 1879

McNaughton, Finlay Donald, Cornwall.....25th Feb., 1899

McPherson, Archibald John, Brockville.....10th April, 1897
B.A.Sc. (Toronto Univ.)

McPherson, Charles Wilfrid, Dawson, N.W.T. c/o Dep't of Interior .....21st Feb., 1899

McPhillips, George, Winnipeg,.....9th July, 1885
D.L.S., P.L.S. (Man.)

Manigault, William Mazyck, Strathroy, P.O. Box 300.....8th July, 1876
D.L.S.

Marshall, James, Holyrood.....6th Oct., 1866
D.L.S.

Meadows, William Walter, St. Thomas.....21st Feb., 1898
Grad. S.P.S.

Miles, Charles Falconer, 268 Triangle St., Buffalo, N.Y.....13th Jan., 1862
D.L.S.

Miller, Frederick Fraser, Napanee.....8th Jan., 1885

Moore, John MacKenzie, London, Albion Building.....9th Oct., 1879

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

Moore, John Harrison, Smith's Falls.....11th Nov., 1889
Grad. S.P.S.

Morris, Alfred Edmund, Perth.....10th April, 1879

Morris, James Lewis, Pembroke.....7th July, 1886
D.L.S., C.E. (Toronto Univ

Mountain, George Alphonse, Ottawa.....9th Jan., 1884
Mem. Can. Soc. C.E., D.L.S., P.L.S. (Que.) Chief Eng. Can. Atlantic and O.A. & B. Ry.

Murdoch, William, Toronto, 37 Bloor St. E.....10th Jan., 1860
D.L.S., C.E.

Murphy, Charles Joseph, Toronto, 157 Bay st..6th Oct., 1886

Nash, Thomas Webb, Kingston.....7th April, 1854

Newman, John James, Windsor.....21st Feb., 1898

Newman, William, Windsor,
57 Sandwich st. w.....12th Nov., 1892
Grad. S.P.S.

Niven, Alexander, Haliburton.....8th July, 1859
D.L.S.

Ogilvie, William, Dawson City, Yukon Dist..12th July, 1869
D.L.S. Commissioner for Yukon District.

O'Hara, Walter Francis, Chatham.....14th April, 1892
D.L.S.

Patten, Thaddeus James, Little Current.....5th Jan., 1883

Peterson, Peter Alexander, Montreal, P.Q...16th July, 1863
D.L.S., C.E., Mem. Can. Soc. C.E., Chief Engineer Can. Pac. Ry.

Pinhey, Charles Herbert, Ottawa,
552 Gilmour St.....12th Nov., 1888
D.L.S., Grad. S.P.S., Assoc. Mem. Can. Soc. C.E.

Proudfoot, Hume Blake, Port Arthur.....6th Jan., 1882
D.L.S., C.E. (Toronto Univ.)

Rainboth, Edward Joseph, Ottawa.....11th Nov., 1887
D.L.S.

Rainboth, George Charles, Aylmer, P.Q.....11th July, 1868
D.L.S., P.L.S. (Que.)

Reinhardt, Carl, Montreal, 340 Mountain St.....25th Feb., 1899
B.A.Sc. (McGill.)

Reynolds, Samuel Henry, Rat Portage.....17th July, 1880

Roberts, Vaughan Maurice, St. Catharines...5th April, 1887

Robertson, James, Glencoe.....11th July, 1885
Grad. S.P.S.

Robinson, Franklin Joseph, Kirkfield.....21st Feb., 1898
Grad. S.P.S., Asst. Engineer Trent Canal.

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

Roger, John, Mitchell.....10th Nov., 1888
Grad. S.P.S.

*Rombough, Wm. R., Toronto, 61 Walton St...14th Nov., 1848
D.L.S.

Rorke, Louis Valentine, Sudbury.....14th April, 1890
D.L.S.

Ross, George, Welland.....10th July, 1879
B.A.Sc. (McGill), D.L.S.

*Rubidge, Tom S., Cornwall.....9th Feb., 1849
D.L.S., Asst. Eng. Dept. Rys. and Canals.

Russell, Alexander Lord, Port Arthur.....16th April, 1873
D.L.S., P.L.S. (Que.).

Sankey, Villiers, Toronto, City Hall.....11th Jan., 1878
D.L.S., City Surveyor.

Saunders, Bryce Johnston, Regina, N.W.T.....7th Jan., 1885
B.A.Sc. (McGill), D.L.S.

Scane, Thomas, Ridgetown.....7th Jan., 1865
D.L.S.

*Schofield, Milton C.,
185 14th St. Buffalo, N.Y.....28th Sept., 1843
D.L.S.

Schwitzer, John Edward, Rat Portage.....16th Nov., 1896
Town Engineer, B.A.Sc. (McGill).

Seager, Edmund, Rat Portage.....8th July, 1861
D.L.S.

Selby, Henry Walter, Dinorwic,
Dist. of Rainy River.....8th Jan., 1876
D.L.S.

Sewell, Henry DeQuincy, Toronto, 29 St. Mary St. 9th July, 1885
D.L.S., A.M.I.C.E.

Shaw, John Henry, Pembroke.....17th Feb., 1900
Grad. S.P.S.

Silvester, George Ernest, Sudbury.....12th Nov., 1892
Grad. S.P.S.

Sing, Josiah Gershom, Meaford, P.O. Box 3.....9th Jan., 1879
D.L.S.

Smith, Angus, Stratford.....14th April, 1896
Grad. S.P.S., City Engineer.

Smith, George, Woodville, P.O. Box 77. ...7th April, 1881
Engineer for Co. Victoria and four Townships.

Smith, Henry, Toronto, Crown Lands Dept...8th Nov., 1861
D.L.S., Mem. Can. Soc. C.E.

Speight, Thomas Bailey, Toronto,
Yonge St. Arcade.....6th Jan., 1882
D.L.S.

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

Squire, Richard Herbert, Brantford,
103 Dalhousie St.....14th April, 1896
B.A.Sc. (Toronto University).

Steele, Edward Charles, Port Arthur.....9th April, 1889
Assoc. Mem. Can. Soc. C.E.

Stewart, Elihu, Ottawa, Dept. of the Int.....8th April, 1872
D.L.S., Chief Inspector of Timber and Forestry.

*Stewart, George Alexander, Calgary, Alta....8th July, 1852
D.L.S.

Stewart, John, Montreal.....11th Nov., 1887
D.L.S.

Stewart, Walter Edgar, Aylmer.....12th April, 1892

*Strange, Henry, Rockwood.....30th Nov., 1838
D.L.S., C.E

Stull, William Walter, Sudbury.....17th Feb., 1900
B.A.Sc. (Toronto Univ.)

Taylor, William Verner, Gananoque .....7th Nov., 1896
Grad. S.P.S.

Traynor, Isaac, Dundalk.....16th April, 1873
D.L.S.

Turnbull, Thomas, Winnipeg, Man.,
C. P. R. Eng. Office.....6th July, 1878
D.L.S., C.E. (Toronto Univ)

Tyrrell, James Williams, Hamilton,
42 James st. n.....8th April, 1885
C.E. (Toronto Univ.), D.L.S., Co. Eng. for Wentworth.

*Unwin, Charles, Toronto, 126 Seaton st....12th April, 1852
D.L.S.

Ure, Frederick John, Woodstock.....7th April, 1887
C.E.

Van Buskirk., William Fraser, Rosland .....7th April, 1888
Grad. R.M. Coll. (Kingston), City Engineer.

Van Nostrand, Arthur J., Toronto,
Yonge St. Arcade..... .....30th Oct., 1882
D.L.S.

Wadsworth, Vernon Bayley, Toronto,
103 Bay st.....9th April, 1864
D.L.S.

Wagner, William, Ossowo, Man.....13th April, 1858
D.L.S.

Walker, Alfred Paverley, Toronto, Room 508,
Union Station, C. P. Ry., Eng. Office.....6th Jan., 1882
D.L.S., Mem. Can. Soc. C.E.

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

Wallace, James Nevin,
Calgary, Alta.....21st Feb., 1898
B.A., B.E. (Trin. Coll Dublin).

Ward, Archeson Thomas,
Wabigoon Dist. of Rainy River .....10th April, 1897

Warren, James, Walkerton, P.O. Box 190.....7th Oct., 1864
D.L.S.

Watson, John McCormack, Orillia,
P.O. Box 224.....13th April, 1892

*Weatherald, Thomas, Goderich,
P.O. Box 273.....12th Jan., 1856
D.L.S., C.E.

Weekes, Melville Bell, Brantford.....17th Feb., 1900
B.A.Sc. (Toronto Univ.)

West, Robert Francis, Orangeville.....7th April, 1881

Wheelock, Charles Richard, Orangeville.....7th Jan., 1886
Treasurer County of Dufferin.

Whitson, James Francis, Toronto,
Crown Lands Dept.....9th Jan., 1886

Wicksteed, Henry King, Cobourg.....7th Jan., 1886
D.L.S., C.E.

Wiggins, Thomas Henry, Finch, Ont.....10th Nov., 1891
Grad. S.P.S., D.L.S., Town Engineer.

Wilde, John Absalom, Sault Ste. Marie.....9th April, 1889

Wilkie, Edward Thomson, Carleton Place...11th April, 1891
D.L.S.

Williams, David, 220 Queen St., Kingston..... 9th April, 1864
D.L.S.

*Winter, Henry, Thornyhurst.....11th July, 1853
D.L.S., C.E.

*Wood, Henry O., Billings' Bridge.....10th Oct., 1855
D.L.S.

*Yarnold, William Edward, Port Perry,
P.O. Box 44.....7th April, 1854
D.L.S.

REGISTERED AND WITHDRAWN.

The names of those who have become "Associates" under By-law No. 39 are marked *; and under By-Law No. 45 are marked †.

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

Anderson, John Drummond, Trail, B.C.....13th April, 1892

Apsey, John Fletcher,
Cumberland, Md.....6th Jan., 1886
Grad. S.P.S.

Aylsworth, Charles Fraser, Sr., Madoc.....2nd April, 1861
D.L.S.

Blake, Frank Lever, Toronto,
Meteorological Office .....13th April, 1875
D.L.S.

Bell, Andrew, Almonte.....6th Oct., 1866
D.L.S.

Bolton, Jesse Nunn, Toronto, 264 Major St.....6th April, 1867

Booth, Charles Edward Stewart,
Westmount, P. Q.....6th April, 1882

Bowman, Arthur Meyer, Mahan,
Beaver Co., Pa.....11th Nov., 1887
Grad. S.P.S., Staff of U.S. Engineers.

Bowman, Franklin Meyer, Bellevue,
Allegheny Co., Pa.....11th April, 1892
Grad. S.P.S., Engineer Structural Iron Works.

Brady, James, Victoria, B.C., P.O. Box 815..15th July, 1862
M.E.

Burnet, Hugh, Victoria, B.C.....5th April, 1887
P.L.S. (B.C.).

Cambie, Henry John, Vancouver, B.C.....8th July, 1861
P.L.S. (B.C.).

Carbert, J. Alfred, St. Joseph, Mich.....7th April, 1876
D.L.S. Staff of U. S. Engineers.

Coleman, Richard Herbert, Toronto, Canada
Co. Offices, Imperial Bank Chambers....6th Oct., 1877

Drewry, William Stewart, Ottawa,
Dept. of the Interior.....5th April, 188
D.L.S.

Edwards, George, Thurso, P.Q.....6th Jan., 1866
D.L.S.

*Ellis, Henry Disney, Kuching, Sarawak,
Borneo .....7th April, 1877
D.L.S., Commr. of Pub. Works and Surveys.

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

Galbraith, John, Toronto,
School of Prac. Science.....13th April, 1875
M.A., D.L.S., Prof. Engineering, S.P.S.

Gibbons, James, Ottawa, Dept. of the Interior...15th April, 1890
Grad. S.P.S., Dominion Topographical Surveyor.

Gibson, George, St. Catharines.....10th April, 1860
D.L.S.

*Gilmour, Robert, Toronto, c/o Western
Loan Company.....11th April, 1856
D.L.S., C.E

Green, Thomas Daniel, Dawson City .....7th Jan. 1885
D.L.S.

Griffin, Albert Dyke,
Collegiate Institute, Woodstock.....11th Nov., 1890
B.A., Mathematical Master.

*Harris, John Walter, Winnipeg .....6th Oct., 1866
P.L.S. (Man.), D.L.S., Assessment Com.

Henderson, Eder Eli, Henderson P.O.,
Maine .....7th April, 1887
Grad. S.P.S.

Hermon, Ernest Bolton, Vancouver, B.C.....7th Oct., 1885
P.L.S. (B.C.), D.L.S.

Innes, William Livingstone, Simcoe.....14th April, 1892
C.E. (Toronto Univ.).

Jephson, Richard Jermy, Calgary, Alta.....7th April, 1877
P.L.S. (B.C.), D.L.S.

Johnson, Sydney Munnings, Greenwood, B.C..9th Nov., 1895

Johnston, Robert Thornton,
New York, N.Y., 944 Amsterdam Ave.....9th April, 1889

Kains, Tom, Victoria, B.C.....11th July, 1873
D.L.S. P.L.S. (B.C.).

Kirk, John Albert, Rossland, B.C.....6th July, 1877
D.L.S., P.L.S. (B.C.)

*Kippax Hargreaves, Huron, South Dakota.....7th July, 1877
C.E. (Toronto Univ.), Assistant to Surveyor General.

*Klotz, Otto Julius, Ottawa, 437 Albert st.....6th Jan., 1876
C.E. (Mich. Univ.), Dominion Topographical Surveyor.

Lane, Andrew, Sparrow's Point, Md.....4th April, 1895
Grad. S.P.S., Draftsman Maryland Steel Co.

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

Lendrum, Robert Watt,
South Edmonton, Alta.....8th Jan., 1874
D.L.S.

Livingstone, Thomas Chisholm,
Winnipeg, Man.....10th Jan., 1859
D.L.S.

MacLeod, Henry Augustus F., Ottawa,
340 Cooper st.....11th Oct., 1856
C.E., D.L.S.

McCulloch, Andrew, Lake Nelson, B.C.....
Grad. S.P.S., Assoc. Mem. Can. Soc. C.E., City Engineer,

*McMullen, William Ernest,, St. John, N.B..11th Nov., 1892
Asst. Eng. C. P. Ry.

Magrath, Charles Alexander, Lethbridge, Alta..1st Nov., 1881
B.A.Sc. (McGill), D.L.S., P.L.S. (B.C.).

Moore, Thos. Alexander, London South....12th Nov., 1892

Munro, John Vicar, New York, N.Y.,
359 West 31st st.....9th April, 1895

Paterson, James, Allison, Lauzon, P.Q.....5th April, 1878
C.E., Mem, Can. Soc. C.E.

Pearce, William, Calgary, Alta.....12th Oct., 1872
D.L.S., P.L.S. (B.C.).

Ponton, Archibald William, Ottawa,
Dept. of Interior.....9th April, 1880
D.L.S.

Pope, Robert Tyndall,—— — Ireland.....13th April, 1875
C.E., D.L.S.

Purvis, Frank, Mesa City, Arizona.....7th April, 1875

Reid, John Lestock, Prince Albert, Sask.....8th April, 1870
D.L.S.

Reiffenstein, James Henry, Ottawa,
Dept. of the Interior.....16th April, 1873
D.L.S.

Reilly, William Robinson, London,
361 Simcoe st.....7th April, 1881
D.L.S., P.L.S. (Man.)

Ritchie, Nelson Thomas, Kipiegan, Man.....9th Nov., 1888

Rogers, Richard Birdsall, Peterborough.....9th Jan., 1879
B.A.Sc. (McGill), D.L.S.

*Ross, Joseph Edmund, New Westminster,
B.C. .....11th Nov., 1890
P.L.S. (B.C.).

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

Sanderson, Daniel Leavens, Coral, Mich.....4th Oct., 1882

Shaw, Charles Æneas, Greenwood, B.C.....6th Oct., 1877
P.L.S. (B.C.).

Sherman, Ruyter Stinson, Vancouver, B.C..12th April, 1890
P.L.S. (B.C.).

Simpson, George Albert, Winnipeg Man.....7th Oct., 1864
C.E., D.L.S., M.P.

Spry, William, Toronto.....19th July, 1858
C.E., D.L.S.

*Stewart, Louis Beaufort, Toronto,
School of Prac. Science.....6th April, 1882
Dominion Topographical Surveyor, Lect. in Surveying.

Strathern, John, Vancouver, B.C.....5th Oct., 1876
P.L.S. (B.C.), D.L.S.

Tracey, Thomas Henry, Vancouver, B.C.....8th April, 1870
C.E., P.L.S. (B.C.), D.L.S.

Vicars, John Richard Odlum, Kamloops, B.C..5th Jan., 1887
D.L.S., P.L.S. (B.C.).

Wallace, Charles Hugh, 36 Dame St., Dublin, Ire., 9th Nov. 1889
C.E. (Trin. College, Dublin), Dom. Gov. Surveyor.

Weekes, Abel Seneca, Wetaskiwin, Alta....12th April, 1890
D.L.S.

Wheeler, Arthur Oliver, New Westminster,
B.C. .....8th July, 1881
P.L.S. (B.C.), D.L.S.

Willson, Alfred, Toronto, Can. Co. Offices,
Imperial Bank Chambers.....6th Oct., 1866
D.L.S., Commissioner Canada Company.

Wilkins, Frederick William, Ottawa,
Dept. of the Interior.....6th Jan., 1877
Dominion Topographical Surveyor.

SUMMARY.

Active members subject to dues.....	196
Active members exempted from dues	19
Withdrawn from practice (including 9 Associates)	69
Dead	34
Total number enrolled since incorporation.....	318

Deceased Members.

NAME.	LATE RESIDENCE	DATE OF P. L. S. CERTIFICATE.	DATE OF O. L. S. REGISTRATION	DIED
Bolger, Francis	Lindsay	10th October, 1863	1892	3rd November, 1895.
Bolger, Thomas Oliver	Kingston	6th July, 1865	1892	——— ———
Bowman, Leander Meyer	Toronto	14th April, 1892	1892	20th September, 1895.
Brown, David Rose	Cornwall	10th October, 1850	1892	14th May, 1900.
Burke, William Robert	Ingersoll	5th April, 1878	1892	10th June, 1897.
Caddy, Edward C.	Cobourg	18th December, 1846	1892	26th September, 1897.
Coad, Richard	Glencoe	8th October, 1879	1892	17th May, 1897.
Creswicke, Henry	Barrie	8th July, 1864	1892	22nd January, 1898.
Cromwell, Joseph M. O.	Perth	1st October, 1846	1892	19th October, 1897.
Davidson, Walter Stanley	Sarnia	9th April, 1884	1892	December, 1900
Deane, Michael	Windsor	26th May, 1848	19th December, 1892	3rd April, 1897.
DeGurse, Joseph	Windsor	5th April, 1883	1892	22nd March, 1898.
FitzGerald, James William	Peterborough	13th July, 1857	1892	———, 1901.
Foster, Frederick Lucas	Toronto	9th April, 1863	1892	27th July, 1899.
Fowlie, Albert	Orillia	13th January, 1863	1892	—— April, 1898.
Gibbs, Thomas Fraser	Adolphustown	31st May, 1841	1892	17th April, 1893.
Gilliland, Thomas Brown	Eugenia	11th July, 1868	25th January, 1890	14th December, 1898
Haskins William	Hamilton	5th July, 1855	1892	5th July, 1896.
Hewson, Thomas Ringwood	Hamilton	6th July, 1877	1892	21st October, 1898.
Howitt, Alfred	Gourock	12th January, 1856	1892	6th May, 1896
Kirk, Joseph Green	Stratford	16th February, 1843	1892	22nd January, 1900.
Lynch-Staunton, Francis H.	Hamilton	11th October, 1856	1892	11th June, 1899.
MacMillan, James Alexander	Calgary	6th January, 1877	24th December, 1894	——— ———, 1898.
MacNab, John Chisholm	Hamilton	8th January, 1880	1892	16th October, 1897.
McCallum, James	Fort Francis	30th March, 1849	1892	—— July, 1900.
Malcolm, Sherman Morgan	Blenheim	11th October, 1858	1892	13th January, 1899.
Ogilvie, John Henry	Rat Portage	8th April, 1876	24th April, 1894	21st September, 1898.
Pedder, James Robert	Doon	10th November, 1891	23rd December, 1892	17th January, 1897.
Reid, James Hales	Bowmanville	6th October, 1866	1892	22nd December, 1899.
Robinson, William	London	—— May, 1846	1892	11th October, 1894.
Tiernan, Joseph Martin	Tilbury Centre	7th January, 1886	1892	December, 1900
Thomson, Augustus Clifford	Chicago	14th January, 1861	1892	—— December, 1896.
Walsh, Thomas William	Simcoe	25th April, 1842	1892	14th March, 1895.
Wheelock, Charles John	Orangeville	——— ———, 1856	1892	4th July, 1897.

EXTRACTS FROM THE

BY-LAWS AND STATUTES

RELATING TO THE

ADMISSION AND EXAMINATION OF

Ontario Land Surveyors.

BY-LAWS.

EXAMINATIONS.

Examination of candidates for apprenticeship

28. Candidates for admission to apprenticeship are to be examined as follows, in the subjects prescribed in Rev. Stat. Ont., c. 180, s. 22; and no candidate shall be admitted unless he obtains at least the minimum marks set opposite each subject, and at least a total of 550.

Subject.	Max. Marks.	Min. Marks.
1. Penmanship	50	30
2. (*a*) Orthography (including dictation)	50	40
(*b*) English Grammar	50	25
3. Arithmetic (Fractions, Decimals, Square Root)	100	60
4. Logarithms and Algebra (including Equations 1st Degree)	100	60
5. Euclid (Books 1, 2, 3 and 4)	100	60
6. Plane Trigonometry and Rules for Spherical	100	50
7. Mensuration of Superficies	50	30
8. Linear Drawing (use of ruling pen and construction of scales)	50	25
9. Canadian and General Geography	50	25
10. Canadian History	50	25

Examination of candidates for admission to practice.

29. Candidates for admission to practice are to be examined as follows in the subjects prescribed in Rev. Stat. Ont, c. 180, s. 25; and no candidate will be admitted unless he obtains at least the minimum marks set opposite each subject, and at least a total of 1,000.

Subject.	Max. Marks.	Min. Marks.
1. Geometry, including the first 6 books of Euclid, excepting the last thirteen propositions of the fifth book	100	50
2. Algebra (simple and Quadratic Equations, Progressions and Exponents)	100	50
3. Trigonometry (Plane and Spherical)	100	60
4. Mensuration of superficies and laying out and dividing land	150	75
5. Descriptions by metes and bounds	100	75

Subject.	Max. Marks.	Min. Marks.
6. Use and Adjustment of Instruments for surveying and levelling	100	70
7. Laying out of Curves	50	30
8. Practical Astronomy, including finding of Time, Latitude, Longitude, Azimuth, Variation of Compass, and drawing Meridian Lines	150	90
9. Survey Act	150	90
10. Mines Act, Registry Act, Municipal Act, (so far as they relate to surveys and drainage), Ditches and Water-courses Act	100	50
11. Levelling	50	35
12. Principles of Evidence and drawing up Affidavits	80	40
13. Taking of Field notes and preparing of Plans	100	60
14. Geology and Mineralogy, (rudiments of)	75	40
15. Elementary Botany and the Forest Flora of Canada	50	25

30. If a candidate for admission to practice obtains at least the total of 1,000 marks, but fails to obtain the minimum marks in, at least, two of the subjects, such candidate may at a subsequent examination be examined only in the two subjects in which he has failed.

Chapter 180, R.S.O. 1897.

(An Act respecting Land Surveyors.)

* * * * * * *

Meeting of Board and quorum to be fixed

20. The said Board shall meet at the office of the Commissioner of Crown Lands, on the second Monday in the month of February, in every year, unless such Monday be a holiday (in which case they shall meet on the day next thereafter not being a holiday), and may adjourn such meeting from time to time if they deem it necessary. R.S.O. 1887, c. 152, s. 6. 60 V. c. 27, s. 1.

* * * * * * *

APPRENTICES.

Qualification for admission as an apprentice and examination of applicant

22. No person shall be admitted as an apprentice with any Ontario Land Surveyor unless he has previously passed an examination to the satisfaction of the Board of Examiners, in penmanship, orthography, English gram-

mar, arithmetic, algebra (including square-root logarithms and quadratic equations), Euclid (first four books and deductions), plane trigonometry, spherical trigonometry as far as and including the solution of right-angled triangles, mensuration, practical geometry (including the use of ruling-pen and the construction of plane and comparative scales), Canadian and general geography and Canadian history, and has obtained a certificate of such examination and of his proficiency from the Board. 60 V. c. 27, s. 2.

Examination and Certificate Fees.

23. Every applicant shall before being so examined pay to the Secretary-Treasurer of the Association the fees chargeable as hereinafter provided for the said examination and certificate. R.S.O. 1887, c. 152, s. 8.

Notice to be given by Applicants.

24. Applicants for examination previous to apprenticeship shall give one month's notice to the Secretary of the Board of their intention to present themselves for examination, and shall pay to the said Secretary the fee for receiving and entering such notice. R.S.O. 1887, c. 152, s. 9.

QUALIFICATION FOR ADMISSION TO PRACTISE.

Qualification for Admission to Practise.

25. Except as hereinafter provided no person shall be admitted to practise as a land surveyor in and for Ontario until he has attained the full age of 21 years, and has passed an examination before the Board of Examiners in the following subjects, viz., geometry, including the first six books of Euclid (with the exception of the last thirteen propositions of the fifth book), algebra, including progressions, plane and spherical trigonometry, mensuration of superficies, laying out and dividing of land, descriptions by metes and bounds for deeds and other documents, the use and adjustment of surveying and levelling instruments, the laying out of curves, practical astronomy, including finding of time, latitude, longitude, azimuth, variation of the compass, and drawing meridian lines, the Acts relating to the survey of lands in Ontario,

Rev. Stats. c. 136, s. 226, 227.

The Mines Act, The Registry Act, so far as it refers to plans, the Municipal Acts, so far as they relate to roads, surveys and drainage, *The Drainage Act, The Ditches and Watercourses Act*, the theory and practice of levelling, the principles of evidence, drawing of affidavits, taking of field notes and preparing plans, the rudiments of geology and mineralogy, elementary botany and the forest flora of Canada, and the sufficiency of his surveying instruments, and has served regularly and faithfully, for three successive years, except as is in this section hereinafter provided, under an instrument in writing duly executed before two witnesses, as apprentice to an Ontario Land Surveyor, duly admitted and practising therein as such, nor until he has received from the said land surveyor a certificate of his having so served during the said period, or proves to the satisfaction of the Board that he has so served. R.S.O. 1887, c. 152, s. 10. 60 V. c. 27, s. 3.

Apprenticeship.

Attendance of apprentice at School of Practical Science or institution with similar Course of Study

26. Any person serving as an apprentice as hereinbefore provided, may, with the permission of the Board of Examiners attend the Ontario School of Practical Science, or any school, college, or university, the course of study in which is, in the opinion of the Board sufficiently similar to that in the Ontario School of Practical Science, for the purpose of taking any course of study which includes any subjects required for the final examination for admission to practise as a land surveyor, but the total period of such apprenticeship and of such course of study shall not exceed the period of four years from the date of the articles of apprenticeship as above mentioned, and not less than three years of the said period of four years shall be passed in the actual service of a practising Ontario Land Surveyor. 60 V. c. 27, s. 4.

Persons qualified in other Dominions may be admitted to Practice in Ontario.

27. In case a person who has attained the full age of 21 years and who has been practising as a land surveyor in any of His Majesty's dominions other than this Province, shall satisfy the Board of Examiners that the qualifications for practising required of such person in the said dominion, were sufficiently similar to those required in this Province, and shall produce to the said Board his diplomas or certificates, such persons shall not be required to serve as an apprentice, or shall only be required

to serve during such period not exceeding three years as the said Board may consider requisite, after which such person shall, on complying with the other requirements of this Act, have the right to undergo the final examination, or such portions thereof as the said Board may consider necessary, and shall, if found qualified, practise as a land Surveyor in Ontario. 60 V. c. 27, s. 6.

Graduates of Royal Military College, Kingston, or of Ontario School of Practical Science, and McGill College, Montreal, to have certain privileges.

28. The privilege of a shortened term of apprenticeship shall also be accorded to any graduate of the Royal Military College at Kingston, or of the Ontario School of Practical Science, in civil engineering or in mining engineering, or of the McGill College, Montreal, in civil engineering or in mining engineering, and such person shall not be required to pass the preliminary examination herein before required for admission to apprenticeship with a land surveyor, but shall only be bound to serve under articles with a practising land surveyor, duly filed as required by section 32 of this Act, during twelve successive months of actual practice, after which, on complying with all the other requirements, he may undergo the examination prescribed by this Act. R.S.O. 1887, c. 152, s. 14. 60 V. c. 27, s. 7 (1).

Attendance at certain School during apprenticeship.

29. Such person at any time during his apprenticeship may, with the permission of the Board of Examiners, attend the Ontario School of Practical Science, or any school, college, or university, the course of study in which is, in the opinion of the Board, sufficiently similar to that in the Ontario School of Practical Science, for the purpose of taking any course of study which includes any subjects required for the final examination for admission to practise as a land surveyor, but the total period of such apprenticeship, and of such course of study, shall not exceed the period of two years from the date of the articles of apprenticeship as above mentioned, and not less than twelve months of the said period of two years shall be passed in the actual service of a practising Ontario Land Surveyor. 60 V. c. 27, s. 7 (2).

If Surveyor dies, etc., service may be completed with another Surveyor.

30. If a surveyor dies or leaves the Province, or is suspended or dismissed, or ceases to practise, his apprentice may complete his term of apprenticeship, under an instrument in writing as aforesaid, with any registered

surveyor in actual practice. R. S. O. 1887, c. 152, s. 15. 60 V. c. 27. s. 8.

Instruments of Apprenticeship may be transferred.

31. A surveyor may, by an instrument in writing, transfer an apprentice, with his own consent, to another registered surveyor in actual practice, with whom he may serve the remainder of the term of his apprenticeship. R.S.O. 1887, c. 152, s. 16. 60 V. c. 27, s. 9.

Instruments binding to Service to be filed, etc.

32. No instrument in writing under which an applicant for admission to practise as a surveyor claims to have served with some practising surveyor for the required period shall avail to authorize the admission of an applicant, unless the instrument has been transmitted to the Secretary of the Board within two months next after the date thereof, nor unless the fee in respect thereof mentioned in section 39 of this Act was by the apprentice paid to the Secretary of the Board at the time of transmitting the indenture or articles; and the said Secretary shall acknowledge by post the receipt of all such instruments or copies thereof transmitted to him, and shall carefully keep the same filed in his office. R. S. O. 1887, c. 152, s. 17. 60 V. c. 27, s. 10.

ADMISSION OF CANDIDATES.

Notice of examination to be given by candidates for admission.

33. Every person desiring to be examined by the Board as to his quailfication to be admitted as a land surveyor, shall give notice thereof in writing to the Secretary of the Board, at least one month previous to the meeting thereof. R. S. O. 1887, c. 152, s. 18.

Board to be certified of good act, etc.

34. Every person applying for admission to practise as a land surveyor shall produce to the Board satisfactory certificates as to character for probity and sobriety, and before a certificate is granted shall perform such practical operations in the presence of the Board, and shall answer such questions on oath (which oath any member of the Board may administer) with regard to the actual practice of such applicant in the field, and with regard to his surveying instruments, as the said Board may require. R.S.O. 1887, c. 152, s. 19.

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Report [and] proceedings

Engineering

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